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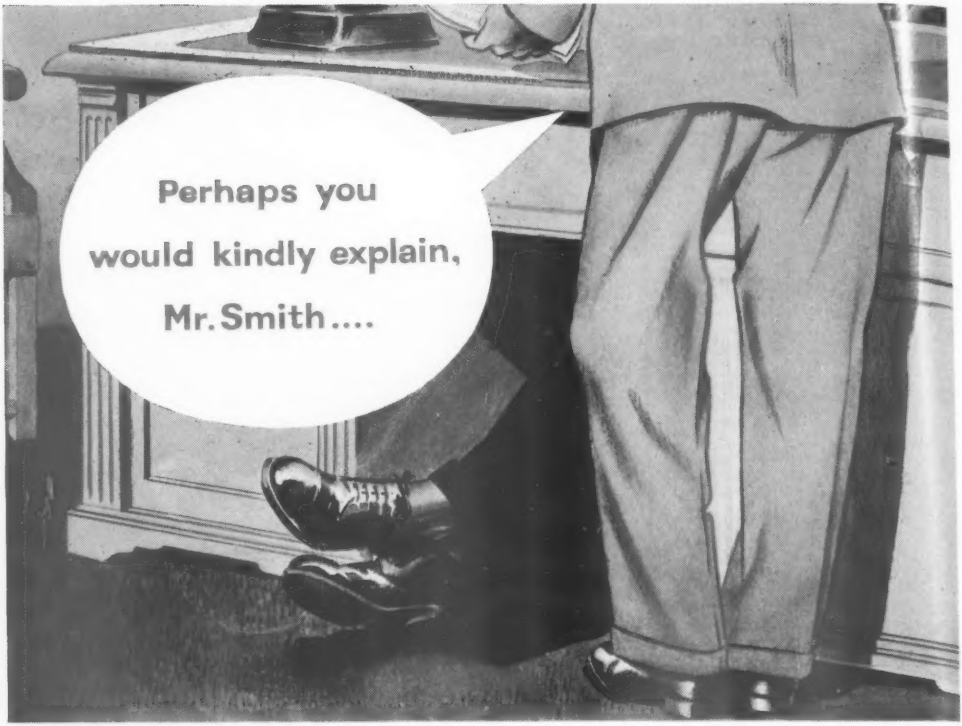

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Plant for Small Jobbing Foundries

In *The Crucible*, the house organ of the American Non-Ferrous Founders Society, there is printed a letter which reads:—"If you attended the Foundry Show in Atlantic City, you were no doubt impressed by the variety of new equipment being offered for automation in large foundries. You and I have contended for some time that equipment for the smaller foundry was being ignored or else was being manufactured on a field basis whereby you and your competitors work out the bugs at your own expense. Certainly, the finished attention given to equipment for large companies is not carried out in the smaller foundry needs. Boss, I believe you'll agree that if some of these manufacturers would explore the market for proper equipment in the medium and small foundry, they would find a most profitable field and I am sure save you a handsome sum. What's your suggestion?" Not quite parallel conditions exist in this country, where the medium-size concern is reasonably well catered for, but the problem of the small foundry is certainly common to all countries.

The solution is not to be found by the design and marketing of small-scale, low-production plant but rather through the joint examination of the difficulties. This will or should involve some of the smaller foundry owners in a series of committee meetings to establish some fundamentals. First, there will have to be agreement as to the principle that the knocking out of moulds must be done in one place; the possibility of a night shift must be established, and there must be some information forthcoming as to potential runs. With this and kindred knowledge available, there would be a fair chance of the establishment of a good layout, supported by the provision of simple, robust machines to aid in the economic functioning of the foundry. So many things are put on the floor and picked up again, that to make a ton of castings, some 150 tons of material are being handled. That, to our mind, is the major problem.

It may be that an examination of the situation will indicate the initial installation of roller pathways as a contribution towards the reduction of handling costs, followed later by plant, the siting of which will become more obvious. A machine which shovels up sand and transports it is popular in the States for the medium-size foundries and is undoubtedly a well-esteemed money-saver. The error must be avoided of imagining that there are dozens of small foundries falling into a set class, each being capable of being subjected to the same treatment for improvement. Often, the only really common denominator is that they all have a handling problem—normally lost sight of because of the few people employed and the difficulty arising therefrom of using the skilled labour to its best advantage.

IVE Annual Conference

Arrangements for the Brighton Meeting, October 4 and 5

The 1956 annual conference of the Institute of Vitreous Enamellers will be held at the Hotel Metropole, Brighton, on Thursday and Friday, October 4 and 5, and the programme is shown below. Members are invited to complete a reply form and return it to the head office of the Institute, Ripley, near Derby, not later than September 14. To accommodate Council's desire to hold conferences in different parts of the country, the south has been selected this year, although the venue is not ideal for arranging works visits. However, a programme of technical papers has been arranged which it is felt will do justice to such a conference. Members are advised to reserve hotel accommodation as soon as possible.

Programme

Thursday, October 4. (*Delegates.*)

10.00 a.m. (Octagon Room.) Annual general meeting. 10.45 special general meeting, and 11.30 "Enamel as a Finish," by T. J. McArthur.

1.00 p.m. Luncheon. (Centre Room.)

2.30 p.m. (Octagon Room.) Symposium on Mechanical Handling:—(*a*) "Pickling and Pre-treatment," by J. Stack, (*b*) "Enamel Application," by W. B. Noon, and (*c*) "Drying and Fusing," by T. Macpherson Lees.

Evening free.

For the ladies attending the conference, a visit to Parham Park and tea at the Manor House Hotel, Storrington, has been arranged, the party leaving the Hotel Metropole at 2.30 p.m.

Friday, October 5. (*Delegates.*)

10.00 a.m. (Octagon Room.) Inauguration of C. R. Wheeler, C.B.E., as president, followed by presidential address; 11.15 technical session: "Abrasion Resistance of Enamels," by B. K. Niklewski, M.Ph., M.S., D.Sc.Tech.

1.00 p.m. Luncheon. (Centre Room.)

2.30 p.m. (Octagon Room.) Technical session. "An Eye to Colour," by E. W. B. Dunning; 3.30 p.m. discussion session: "Current Mill-room Practice," by S. H. Ryder, B.Sc., A.R.I.C., A.I.M.; 4.15 p.m. Film Show: "Titanium Pigment Story."

7.30 p.m. Reception by the president and Mrs. C. R. Wheeler, and the chairman and Mrs. W. Thomas at the Winter Gardens, followed at 8.00 p.m. by the annual banquet in the Clarence Room, and dancing in the Winter Gardens until 1.00 a.m.

Atomic Energy Department for B & W

Formation of an atomic energy department is announced by Babcock & Wilcox, Limited. The department will be responsible for development, proposition, and contract engineering in the atomic energy field and will operate in close collaboration with the existing sales, engineering, commercial, and manufacturing departments of the organization. It will be under the direction of the company's chief engineer, Mr. W. F. C. SCHAAP, who has been a director of the company since April, 1954.

Mr. T. B. WEBB is appointed chief engineer and manager of the new department, with Mr. W. R. WOOTTON as assistant manager. The position of chief research engineer, vacated by Mr. Webb, will be filled by Dr. W. B. CARLSON, at present assistant to Mr. Webb. The atomic energy department will be operative from October 2.

Profits and Price Cutting*

The chart illustrated below indicates the additional business which must be obtained to achieve the same total of net profit if the price of any commodity be cut by three, five, 7½, or 10 per cent., and so on. It shows the almost impossible task of making up for indiscriminate price cuts on the assumption that increased business will result.

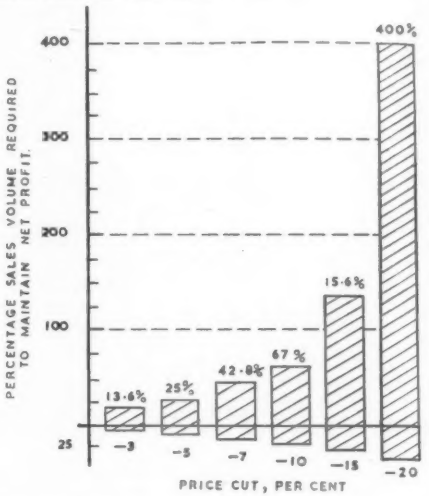


Chart showing the increased business necessary to secure the same net profit despite price cuts of increasing severity. The original level of trading produced a net profit of 25 per cent.

* Abstracted from "The Crucible" the house-organ of the Non Ferrous Founders Society, Inc. (of America)

British Oxygen's Welding Tuition Charges

From September 1 the cost of tuition for all the oxy-acetylene welding courses organized by British Oxygen Gases, Limited, is being increased, from £7 to £10. The company has organized these courses, each of which lasts for two weeks, since 1935, always at a considerable loss. In spite of the price increase, which has been made to meet increases in the cost of materials used, they will still be run at a loss.

The courses are mainly for the benefit of customers' operators. Nearly 1,500 students attend annually at the various British Oxygen welding schools at Cricklewood, Glasgow, Chester-le-Street, Manchester, Leeds, Birmingham, Cardiff, and Bristol. Some students come from overseas.

The price of the oxy-acetylene cutting course remains unchanged at 15s. per day, while there is also no change in the £11 5s. charge for the Argonarc welding course.

THE Metallurgical Equipment Export Company, Limited, and the Indian Steelworks Construction Company, Limited, have moved into new offices at Abford House, 15, Wilton Road, London, S.W.1 (telephone: TATe Gallery 8191).

Emissions from Cupolas*

By F. M. Shaw, G.I.Mech.E.

MR. F. M. SHAW, since 1951, has been a member of the British Cast Iron Research Association foundry atmospheres team. He was educated at Priory School, Shrewsbury, and Shrewsbury Technical College, and prior to serving as an engineer in the Royal Navy, he spent two years in the gas industry. On demobilization, Mr. Shaw trained in the foundry of Sentinel (Shrewsbury), Limited, and later underwent a course of training at the National Foundry College, whose diploma he gained in 1949. In that year he took up a position with Coneygre Foundry, Limited, which he relinquished in 1951 to take up his present position.

Cupolas in the United Kingdom emit some 40,000 tons of solid matter per year; the stack gases carrying these solids are fairly large in volume, hot, and potentially corrosive. A considerable number of types of dust-collector have been used, or suggested for use, on cupolas. The most popular type (consisting of an expansion chamber and baffle) is very inefficient, and collects only the heaviest particles. To obtain collection efficiencies of over 70 per cent. (by weight) fairly-expensive equipment is needed. For efficiencies of over 90 per cent., very elaborate and expensive collectors must be used, e.g. electrostatic precipitators or bag filters. The simple baffle- and water-spray type of collector will remove about half of the dust in the stack gases, and offers the cheapest means of achieving a reasonable degree of cleaning. The particles escaping this type of collector are fairly small, and unlikely to constitute a nuisance. Fume is formed in the cupola, and due to its small particle size can only be removed by the most efficient collectors. Smoke from dirty scrap, etc., consisting of even smaller particles, is correspondingly more difficult to remove, but may be minimized by ensuring complete combustion of the stack gases. Of the gases present in the stack, only two are of importance. Carbon-monoxide, because of its toxic nature, must be burned to harmless carbon-dioxide, or kept well clear of the operators. Sulphur-dioxide, present in small quantities, can cause rapid corrosion of steelwork in the presence of moisture.

Introduction

The growing awareness of air pollution as a national problem is causing foundrymen to seek more-efficient means of suppressing the dust, fume and smoke emitted by cupolas. It is estimated that cupolas in the United Kingdom emit some 40,000 tons of solid matter per year. This figure is based on a yearly output of 3½ million tons of castings and 25-lb. of dust per ton of metal melted, and may be compared with the Beaver Report's† estimate of 100,000 tons per year for the dust emitted by railway locomotives alone.

Before a dust collector can be designed for a particular purpose, a number of factors should be known. These include the weight, composition and particle-size of the dust to be collected, together with the temperature, composition and volume of the gas in which the dust is suspended. The available information on these factors has been collected and summarized. The solid portion of cupola emissions consists of dust, fume and smoke, and in the past, it was often assumed that the fitting of a simple expansion chamber and baffle to the cupola top would provide a cure. It is now recognized that this type of installation, although appreciably reducing roof-maintenance, is very inefficient, and is only capable of collecting heavy particles. There are many types of dust collector available which can be adapted for use on cupolas, and an attempt is made in this Paper to compare their various efficiencies.

The most efficient types of collector so far tested on cupola dust, are the fabric filter and electrostatic precipitator, both of which enable collecting efficiencies of well over 90 per cent. to be achieved. However, most foundries will have to be content with dust collectors of more modest cost and efficiency. In the range of medium efficiency, and comparatively-low capital and running costs, is the simple spray- and baffle-type collector. This will remove about 50 per cent. of the dust in the stack gases, and also about one-third of the sulphur-oxides. Since it is considered that this type of collector, in combination with complete combustion of the stack gases, provides an economical means of reducing the cupola nuisance to acceptable limits, more information has been given regarding it than about any other type of collector. It should be noted that even though only about half of the dust is removed, the nuisance in terms of the maximum rate of deposition is reduced to very much less than half[28].

* Presented at the annual conference of the Institute of British Foundrymen in Cardiff, last June.

† Report of Committee on Air Pollution (Cmd. 9322), H.M.S.O., 1954.

The fume emitted can only be collected by highly efficient and, consequently, expensive installations, because of its small particle size. Even more difficult to remove is smoke, which has an even smaller particle size. Every effort must be made therefore to ensure that as little fume and smoke as possible is present at the stack exit. Smoke, due to incomplete combustion below the charging door, can be consumed above the charging door if conditions favourable to combustion are maintained.

Carbon-monoxide is present in cupola gases in amounts up to some 16 per cent.; thus, gas emission at the charging door is potentially dangerous and has caused a number of accidents. The cupola must be designed and operated therefore to minimize this hazard. The maintenace of a negative pressure at the charging door is essential if

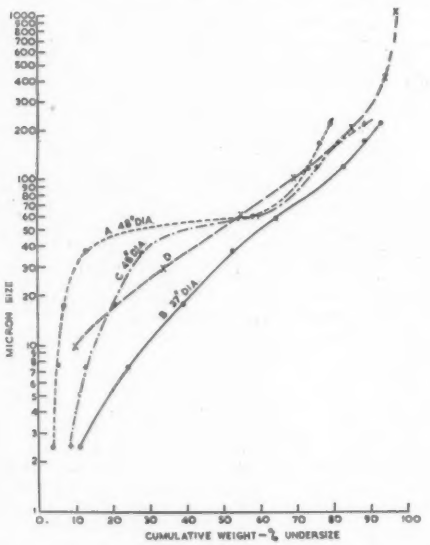


FIG. 1.—*Particle-size analysis of dust emitted by cupolas.*

Curves A, B and C are derived for the respective furnace diameters from data given in (American) Bureau of Mines circular No. 7627, April, 1952, "Actual Dusts from Cupolas" (Gray Iron Founders "Smog" Committee Report). Curve D was taken from *The Foundry*, February, 1950, "Idealized Distribution."

men are employed on the charging platform. In addition, combustion at this point will burn both carbon-monoxide and much of the smoke. Sulphur-oxides are present in cupola-stack gases in sufficient quantity to produce serious corrosion in the presence of moisture, with the result that in wet-collector systems, some form of neutralization of the wash water is essential if the water is re-circulated.

Factors Affecting Cupola Dust and Fume Emission

The gases leaving the stack of a cupola carry with them some 10 to 50 lb. of particulate matter per ton of metal melted. The amount of dust emitted depends on a number of factors, amongst which are the following:—(1) Weight and characteristics of the charge coke. A high coke:metal ratio will obviously produce more dust per ton of metal melted. A friable coke will make more dust than a hard one; (2) amount of sand, *etc.*, adhering to return scrap, sand-cast pig-iron, and so on; (3) amount of "fines" in the limestone, and its friability; (4) dust from other additions, *e.g.* fluor-spar, soda ash; (5) height of the charge: the higher the charge, the greater the possibility of trapping a particle before it can escape up the stack; (6) velocity of gases (the greater the gas velocity, the heavier the particles that can be blown up the stack); (7) method of charging, *e.g.* bucket charging causes an increase in gas velocity between the bucket and the lining which can assist in carrying particles up the stack; and (8) ash in the coke.

The gas velocity depends on:—(*a*) The blast volume per unit cross-sectional area of stack; (*b*) gas temperature; (*c*) dilution at the charging door; and (*d*) whether or not the stack has a parallel lining.

Fume and smoke are caused by:—(1) Iron oxide formed in the melting operation; (2) iron oxide present in the charge; (3) grease, oil and paint on scrap; (4) volatiles from zinc, lead, white-metal bearings in scrap, *etc.*; and (5) wood or an incorrectly-adjusted oil burner being used to ignite the bed coke (lighting-up period only).

Stack Gases

In addition, the stack effluent will contain carbon-dioxide, which is harmless; carbon-monoxide, nitrogen, sulphur-dioxide and oxygen. The carbon-monoxide is caused by the incomplete combustion of coke. Its presence makes it essential that there should be no emission from the charging door if men are present on the charging platform. If the temperature is high enough, carbon-monoxide may not be present above the charging door, since air entering the door will cause its combustion. Nitrogen forms four-fifths of the combustion air and passes through the cupola unchanged. Sulphur-dioxide comes from sulphur in the coke. This fortunately becomes intolerable to operators before it becomes dangerous. The concentrations observed vary from 25 to 250 parts per million by volume of the stack gases[3]. Sulphur-dioxide is, however, very corrosive in the presence of moisture, when sulphurous acid (which oxidizes to the even more corrosive sulphuric acid) is formed. Any oxygen present is caused by excess air induced at the charging door.

Dust is carried up the cupola stack by the velocity of the gases. The gas volume passing up the stack is considerably greater than the blown-air volume, since the temperature is much higher than at the blower and considerable dilution may take place at the charging door. Since the gas temperature and volume influence the choice and cost of any cleaning equipment, it is worthwhile to consider the conditions likely to be encountered in service.

Cupola Gas Temperature and Volumes

The temperature of the stack gases below the charging door is variable and depends to some

extent on the design and operation of the cupola. A low stockline, high bed[11] and high coke : metal ratio all increase the stack-gas temperature. If a closed charging-door is used, the volume of the stack gases at the cupola top will be lower. Air entering an open charging-door may burn the carbon-monoxide present and thus raise the stack-gas temperature, and consequently its volume. In addition, the induced air increases the stack-gas volume. As a rough guide, the following gas temperatures may be accepted :—

Gas temperature below charging door (open or closed), normal working	300 to 700 deg. C.
Gas temperature at stack top (open charging-door with combustion of carbon-monoxide in the case of the higher temperatures)	200 to 900 deg. C.
Gas temperature at stack top, blowing down (open charging-door, assuming combustion of carbon-monoxide)	1000 to 1250 deg. C.
Gas temperature at stack top, blowing down (open charging-door with no combustion of carbon-monoxide	approx. 550 deg. C.*
Gas temperature at stack top, blowing down (closed charging-door)	approx. 800 deg. C.*

* Only one figure available.

The effect of air induced through an open charging-door is thus to raise the stack-gas temperature, if combustion of carbon-monoxide occurs, but to lower it if there is no combustion. It appears that combustion can take place if the gas temperature is in excess of some critical figure which depends on the percentage of carbon-monoxide present, but is in the region of 450 deg. C. The stack-gas volume below the charging door is proportional to the absolute temperature in the stack, (alterations in the volume caused by combustion are ignored in this instance—in point of fact, the volume will increase slightly due to the formation of carbon-monoxide: C+1 vol. 0_2=2 vol. CO), *viz*:

Stack-gas Temperature deg. C.	Approximate factor for multiplying the blown Volume to arrive at the Stack-gas Volume Below the Charging Door.†
400	2.3
600	3.0
800	3.7
1,000	4.4
1,200	5.1

Assuming air temperature at the tuyeres of 15 deg. C. and atmospheric pressure in both cases.†

The degree of dilution of the stack gases by air entering the charging door will depend on: (1) The stack draught at the charging door, which will increase with stack height and temperature, but decrease with any obstructions above the door (*e.g.* reduced shaft diameter or the employment of a non-powered dust collector), and (2) the size of the charging door.

In some cases, the pressure at the charging door is approximately atmospheric, especially before the stack becomes hot, and little or no air enters the charging door. This is dangerous, since carbon-monoxide-laden gas is then liable to puff out on to the charging platform.

A number of measurements and estimates have been made of the weight of air induced at open charging-doors. The figures given are somewhat scattered, but it seems that the range of air dilution by weight likely to be encountered in most cupolas is 50 to 300 per cent. of the blown air. The weight induced will vary during the blow, being lowest at the beginning of the blow when the stack is cool, rising to a maximum during the blowing-down period when the stack is at its hottest.

Using the preceding statements to work out a typical case, if one takes a blown-air volume of 1,400 cub. ft. per min. (for a cupola of approximately 26-in. lined dia.), then the stack-gas volume below the charging door is likely to be about 3,700

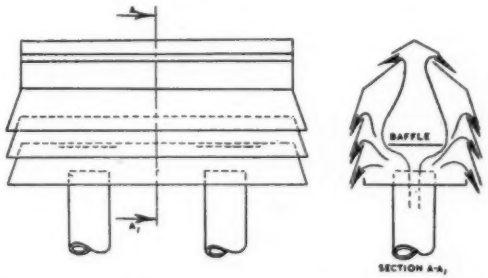


FIG. 2.—*Penthouse type of expansion/deflection device erected on the top of one or more cupolas to induce the deposition of dust.*

cub. ft. per min. (gas temperature, 500 deg. C.). After dilution at the charging door and a rise in temperature due to combustion of carbon-monoxide, this becomes some 12,500 cub. ft. per min. (150 per cent. induced air weight and gas temperature of 750 deg. C.). McCabe[8] quotes for the conditions at the stack top 146,500 cub. ft. of mixed air and gas per ton of metal melted at a temperature of 320 deg. C. as being the average gas-flow for normal cupolas. This is roughly equivalent to 6,000 cub. ft. per min at 320 deg. C. in a 26-in. cupola (the gas temperature at 320 deg. C. seems to indicate that no combustion of carbon-monoxide is assumed). Reducing the 12,500 cub. ft. per min. at 750 deg. C. and 6,000 cub. ft. per min. at 320 deg. C. to a common temperature of 15 deg. C. gives volumes of 3,520 and 2,910 cub. ft. per min., respectively, which is reasonably close agreement.

It has been frequently stated that by inducing air at the charging door or in a collector, the stack gases are cooled, thus giving a reduction in volume and velocity, and allowing smaller particles to gravitate out of the dust stream. The velocity,

however, is not reduced, since the increase in volume of the induced air, when heated up to exit-gas temperature, more than compensates for the reduction in volume of the cooled stack-gases. In the case of a non-powered collector (of the type shown later in Fig. 3 (*b*)) the actual induction volume to be expected depends very much on the wind velocity over the top, and the inlet area. A 5-ft. dia. by 20-ft. high collector fitted to a cupola of 3-ft. 6-in. shell dia., with inlet and exit areas of 7.5 and 13.9 sq. ft., respectively, gave dilution volumes of 2,200 to 8,200 cub. ft. per min (blown-air volume 2,400 cub. ft. per min.) with wind speeds of 0 to 30 m.p.h. An American source[6] gives an air dilution of twice the weight of combustion

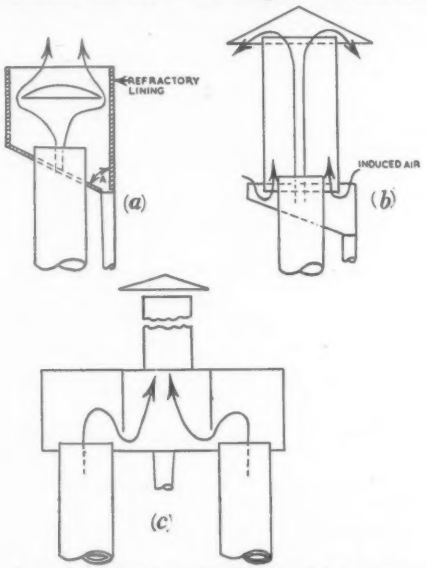


FIG. 3.—*Three designs of expansion/deflection type deflectors for cupolas. Types* (*a*) *and* (*b*) *are usually separately mounted and type* (*c*) *usually serves two or more furnaces.*

gases in the stack, but does not say whether the gases were measured before or after dilution at the charging door. This particular installation consisted of an open-topped 12-ft. high, 7-ft. 6-in. dia. cylinder mounted over a cupola of 56-in. shell dia. A chart showing the relation between initial gas temperature, weight or volume of induced air, and the final gas volume, is given in Appendix C.

Particle Size of Cupola Emissions

There have been many sieve analyses of the dust removed from cupola stacks by various collectors, but these only represent the particle sizes actually removed and neglect the finer particles that pass out. The size distribution of the dust emitted will vary with the type of coke, velocity up the stack, etc.

It is by no means easy to sample the dust from a cupola-stack top. However, because of the necessity of complying with stringent air-pollution codes in Los Angeles, the Gray Iron Founders Society's "smog" committee in that city had some tests carried out on three cupolas by a technical sub-committee, which published a report in December, 1948,[2] giving the weight of dust in various size ranges found from analysis of the dust from these cupolas. On the assumption that the average particle size for each range lies half way between the range limits, these results have been plotted as cumulative percentage graphs (Fig. 1).

The specific gravity of the substances making up cupola emissions covers a wide range, from 1.3 to 7.5.[5] Comparatively-simple equipment will remove

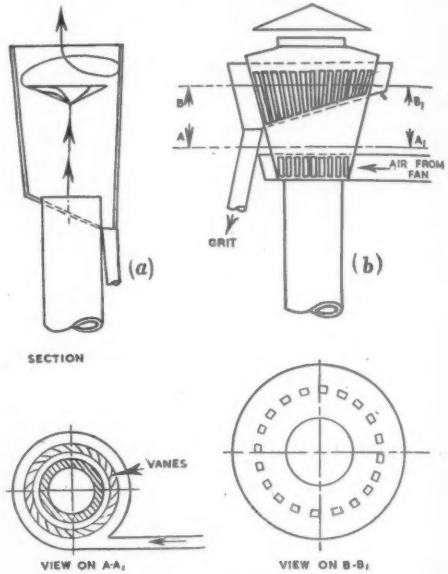


FIG. 4.—*Two types of collector having a cyclonic action:* (*a*) *utilizing stack draught and* (*b*) *tangentially blown air.*

particles over 74 microns (sieve size 200, which from the graphs in Fig. 1 represent about 40 per cent. of the emission by weight) even if these have a fairly-low specific gravity, *e.g.*, coke. More-elaborate equipment is needed if all particles above, say, 44 microns are to be eliminated (sieve size 325 and 45 to 75 per cent. by weight of the dust produced). To remove particles much below 44 microns calls for elaborate and expensive equipment, but American foundries in some air-pollution control districts are being compelled to instal such equipment to comply with the emission rates allowable.

The problem, then, to be faced is that of cleaning fairly large volumes of very hot, potentially corrosive gas, containing particles ranging in size from smoke particles of under 1 micron to pieces of coke about 1-cm. in diameter.

METHODS USED TO SEPARATE DUST FROM CUPOLA GASES

Particle separation from cupola gases can be accomplished by applying the same principles and methods normally used to clean other gases. Any of the following may be used, singly or in combination:—

(1) Expansion of the gases. This reduces the gas velocity, and causes the heavier particles to settle out by gravity. By itself, this method cannot remove any but the heavy particles (down to, say, 150 microns) unless uneconomical expansion ratios are employed.

(2) Sharp changes in direction of the gas stream —the inertia of the particles tends to make them leave the gas path.

(3) Separation, utilizing mechanically-imposed forces, as in the cyclone, where centrifugal force is used.

(4) Filtration through woven fabrics or particulate beds (*e.g.* bag filters, coke beds, *etc.*).

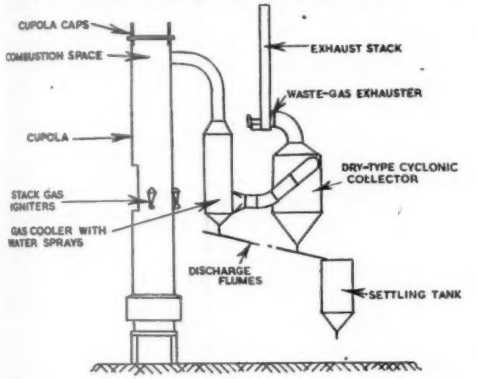


FIG. 5.—*Typical installation of a dry-cyclone cupola dust-collector incorporating water sprays. (D. E. Gilchrist.)*[24]

(5) Scrubbing with water, *etc.*

(6) Separation, utilizing electrically-imposed forces (electrostatic precipitation).

(7) Ultrasonic agglomeration.

(8) Venturi scrubbing.

Application of Principles and Methods

In the following, no attempt is made to quote dust-collection weights (pounds of dust per ton of metal melted) found on test for the collectors described, since these can be misleading for comparison purposes. The weight of dust collected depends primarily on the size and amount of dust produced by the particular cupola to which the collector is attached, and both are variable. Consequently, the same collector on different cupolas could give widely different collection weights. It should also be noted that the efficiencies given only apply for an average cupola dust. If a coarser dust were being collected, the efficiency would be higher, and it would be correspondingly lower for a finer dust. Some collection weights found on test are given in Appendix A.

Expansion:

Few, if any, collectors rely entirely on expansion to deposit particles. A cupola top should not be open to the weather, and this involves some structure (baffle, *etc.*) which deflects the stack gases.

Expansion/deflection:

There are two types of collector that utilize expansion and deflection:—

(1) A penthouse erected over the top of one or more cupolas (Fig. 2). A baffle is usually fitted above each stack, to take the full force of any flame, and so protect the penthouse sheeting and deposit some of the dust by deflection. The expansion ratio naturally

$$\frac{\text{(floor area of penthouse platform)}}{\text{(total stack area of working cupolas)}}$$

affects the weight of dust deposited, and it seems likely that a penthouse having an expansion ratio of about 200, fitted with baffles and a height about equal to its width, will settle out the majority of particles over 150 microns (see Appendix B, for a size analysis of an actual deposit). The collection efficiency is likely to be approximately 20 per cent. by weight.

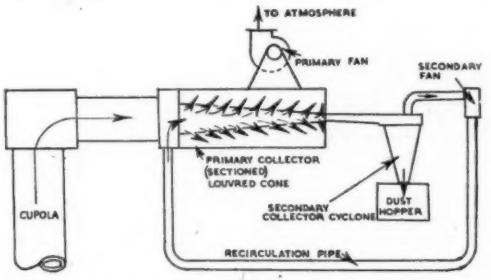


FIG. 6.—*Inertial-type collector.*

(2) An expansion/deflection chamber, usually mounted separately on each cupola (Fig. 3 (a) and 3 (b)). This is the most commonly used collector, and relies on the expansion in the chamber, which is of the order of four times, and the deflection from a baffle or cap over the exit to deposit the dust. As will be realized, the expansion is far less than that in the penthouse type, and the collection efficiency therefore much lower. The efficiency is so low that in many cases no chute is provided for the collected dust, periodical cleaning-out being relied on. Very little dust below 200 microns is removed, and the collecting efficiency is probably 5 to 15 per cent. by weight. Size analyses of two dust samples taken from collectors of the type in Fig. 3 (b) are given in Appendix B. (Note that the type shown in Fig. 3 (a) has a refractory lining, since the shell has to withstand the highest temperatures reached by the stack gases. The type depicted in Fig. 3 (b) allows air to be induced at the base of the shell, which keeps it sufficiently cool

to prevent buckling and excessive oxidation; thus, a lining is not required.

There have been many variations of the expansion/deflection type, *e.g.* a refractory-lined chamber into which two or more cupolas discharge, with various baffling arrangements and a single exhaust stack (Fig. 3 (c)). However, they are all basically similar, and their efficiency is likely to fall between that of the penthouse and the simple expansion-cowl-and-baffle types.

Cyclonic Action :

It is possible to increase slightly the efficiency of expansion-cowl-and-baffle collectors by using a baffle which causes the gases to whirl around inside the cowl and so throw out some dust by centrifugal action, and various Patent systems exist for achieving this (Fig. 4 (*a*)). If, however, the only motive

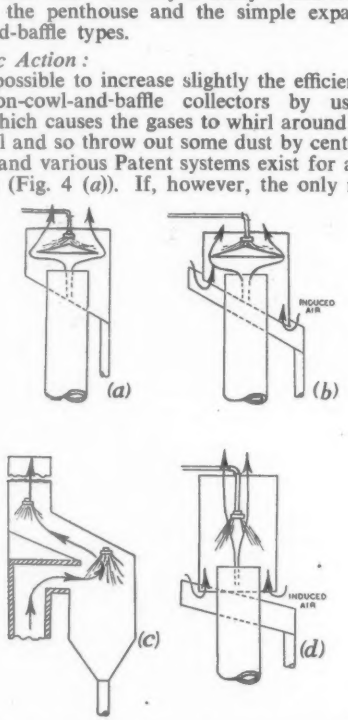


FIG. 7.—*Various designs of wet-type collectors : (a) simplest type of expansion/deflection with a water spray; (b) similar to (a) but with cooling air induced at the bottom; (c) type where the return of washed gases is made to the stack; and (d) utilizing a cone-shaped water spray and no baffle.*

force is the stack draught, the degree of whirl cannot be sufficient to throw out much extra dust, and the increased back-pressure may well cause emission through the charging door.

The cyclonic action can be induced by blowing air in tangentially from a fan (Fig. 4 (*b*)). This results in a much stronger centrifugal action than could be achieved using stack draught alone, and consequently, gives a higher dust-collection efficiency. No information is available on the actual collecting efficiency of this type, but it seems likely that the system will be at least as efficient as a well-designed penthouse, and possibly a little (say, 25 per cent.) higher.

Cyclones or multi-cyclones may be used for cupola gases, provided that the inlet temperature is reduced to about 320 deg. C. by water sprays to prevent oxidation and buckling of the steelwork. The collecting efficiency to be expected is in the range of 50 to 80 per cent., depending on the type of cyclone installed. Water sprays in the cyclone itself are said to increase the efficiency still further[24] (Fig. 5).

Inertial Action :

The fact that particles may be made to leave a gas stream by sharp changes in direction, has been exploited in at least one cupola dust-extraction installation[7] by drawing the stack gases down a cone having louvred sides. The tendency then is for the dust particles to pass right down the cone and to be bled off with a small proportion (about 5 per cent.) of the gases for final cleaning in a cyclone. The bulk of the gases, thus freed of all but the smaller particles, passes through the louvres to the primary fan exhausting to atmosphere (Fig. 6). In the installation described, the dia. cupola top (10-ft. shell) is closed, and a constant exhaust is applied by the primary fan. Some dilution occurs at the charging door. The system seems to remove most particles down to at least 200

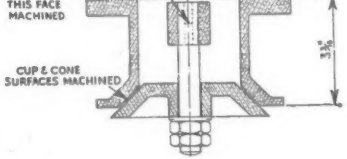


FIG. 7 *continued.*—(*e*) *Section through nozzle developed by W. Y. Buchanan.*

mesh (74 microns), so that its collecting efficiency is about 35 per cent. (based on curves in Fig. 1). A sieve analysis of dust taken from the installation described is given in Appendix B.

Wet-type Collectors

A water spray has been used in various ways to produce reasonably-efficient, cupola-gas cleaners (Fig. 7). The simplest wet-collector is shown in Fig. 7 (*a*), and consists of an expansion/deflection collector with a water spray above the cone baffle. The water keeps the shell cool, and the original refractory lining can be removed. Should the water supply fail, there is the danger of burning out the collector shell, and to prevent this, cooling air may be induced at the bottom, as in Fig. 7 (*b*). One design of wet-collector removes the gases from the cupola stack, and washes and returns them to the stack (Fig. 7 (*c*)). A number of sieve analyses are given in Appendix B of dusts collected by wet-collectors. The efficiency for cupola dust is some 40 to 70 per cent.[9]

The normal type of industrial wet-scrubber can also be used on a cupola. During 1938, such an

installation was made in a New England foundry[10] (Fig. 7 (*k*)). Two cupola tops were closed and the stack gases were drawn off horizontally from above the charging door into a spray chamber. A fan on the "clean" side of the washer powered the system. This was rated to delivery 24,000 cub. ft. per min. and the cupola fans gave a total of 9,800 cub. ft. per min. The efficiency of this type is probably a little higher than that of the spray- and baffle-type.

Cyclonic Action:

The simple wet-collector can be modified to make use of induced cyclonic action in an attempt to increase separation[11] (*i.e.*, a combination of Fig. 7 (*a*) and 4 (*b*)). The collecting efficiency of this type is not known, but is unlikely to be more than 5 per cent. higher than the simple wet-collector (see Fig. 7 (*j*) for an outline drawing. The stack-gases discharge into chamber A. A series of vanes, C, discharge water and air from chamber B, tangentially into A. The mixed stack-gases, water and air, leave A tangentially by the vanes, D.

A centrifugal scrubber has been used[24] (Fig. 8). The gases pass through a wet cyclone, and then up through a series of wet impingement-plates where further dust is collected. The collecting efficiency is given as 76 per cent.[25]

Wet collectors of the simple expansion-chamber, baffle- and spray-type (Fig. 7 (*a*)) seem to offer the most economical method of achieving a reasonable degree of dust removal. Some work on these types has been carried out by the BCIRA and a summary of the findings is given later under

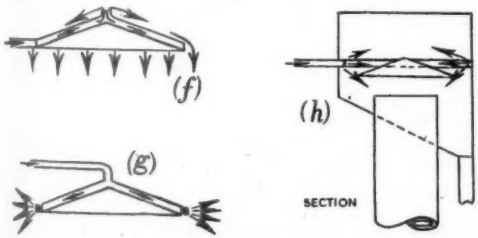


FIG. 7 *continued.—Various arrangements for spraying water into a collector shell: (f) curtain spray falling from a hollow cone; (g) spray from nozzles around the periphery of a hollow cone; (h) ring inside the collector shell directing spray water to the baffle top (see also Fig. 7 (e)).*

"Further Comments on Spray- and Baffle-type Collectors."

Dry Collector and Washer Installation:

A description has been published[4] of a system employing a double-bell charging hopper to reduce the volume and temperature of the gases to be cleaned. The gases are brought down into an expansion/deflection chamber, where the larger particles are collected. The chamber outlet leads to a scrubbing tower (13 lb. water per lb. gas, if the gas figure quoted is the cupola-fan volume). The whole system is powered by the cupola fan and its efficiency is of the order of 70 per cent. (see Fig. 9).

Venturi Scrubber.

The Venturi-scrubber cleaning principle covers the use of liquids injected at a Venturi throat so that liquid droplets and dust particles are made to collide by the turbulence in the throat. The liquid droplets carrying the dust are then removed by a comparatively crude form of collector (usually a cyclone). This system has been tried experimentally on a cupola and gave the rather disappointing collection efficiency of 71.3 per cent.[25]

Devices of Very High Collecting Efficiency

Because of the stringent air-pollution codes adopted in many American cities (notably Los Angeles) a number of elaborate and expensive collectors have been developed.

Electrostatic Precipitators.

Three electrostatic precipitators have been fitted to cupolas situated in the Los Angeles area and a description of one of these (fitted to a 56-in. i.d.

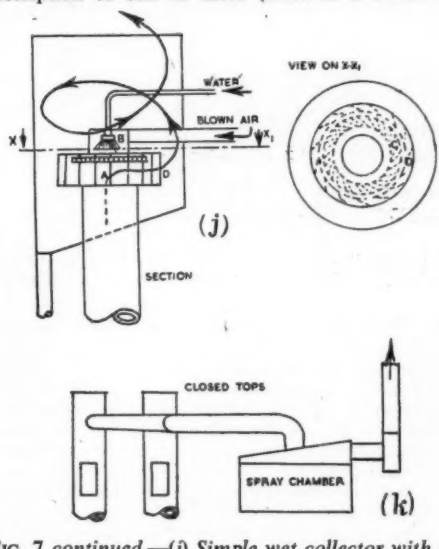


FIG. 7 *continued.—(j) Simple wet collector with the cyclonic action; and (k) a wet collector arranged to serve two cupolas with closed tops.*

cupola) has been published.[28, 29] The gases are first cooled and conditioned by an evaporative cooler absorbing 20 galls. of water per min. This cools the gases from about 800 to 150 deg. C. before entry to the precipitator. On test, this collector gave an efficiency of 94 per cent. The capital cost was $120,000.

Bag Filters.

A difficulty when using a bag filter on a cupola is the high temperature of the gases and some means must be used to cool them, as other-

wise, rapid disintegration of the materials at present used for such filters would occur. The usual system now adopted consists of the evaporative cooler as used in the electrostatic precipitator described previously. Two washers, in series, were also used on an earlier plant[15] to cool the gas to about 40 deg. C. before entry into a cotton bag-filter, the cooling being caused by the latent heat of evaporation of the water. Alternatively, a radiation convection cooler has been employed; [13] in this, the gases enter 16 columns of cooling flues 38-in. in dia., 45-ft. high, arranged as two banks in parallel (see Fig. 10). Some of the gas from the cooler outlet is re-cycled to the inlet to obtain lower maximum temperatures at the inlet and so allow cheaper materials to be used in the construction. The capital cost of such a cooler is higher than that for the evaporative type, but maintenance costs should be less.

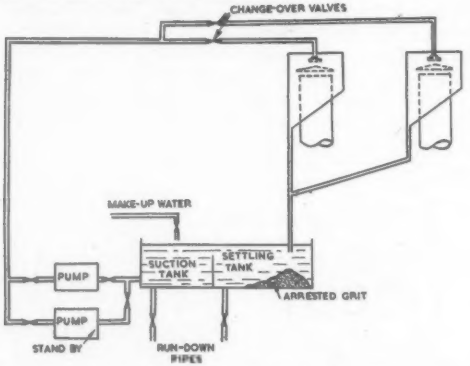


FIG. 7 *continued.*—(*l*) *Typical design of a spray- and baffle-type collector system for two cupolas.*

The filter media employed will depend largely on the degree of cooling to which the gases are subjected. Cotton requires very cool gases (less than 80 deg. C.) if it is not to deteriorate; wool can go up to 100 deg. C.; Orlon has a safe limit of about 135 deg. C., while Fibreglass can be used in temperatures up to 240 deg. C., though it has at present certain disadvantages[30] (poor flexing resistance, etc.). Tests carried out on cotton, orlon, and silicone-treated glass-wool filter installations, all gave collecting efficiencies in excess of 96 per cent.[28, 13]

Regenerative Hot-blast Cupolas

Some dust-collection is inherent in the regenerative hot-blast cupola; the dust may indeed cause serious drops in blast temperature by coating the heat-exchanger walls. In such systems, a dust separator is normally fitted prior to the heat-exchanger, usually of the expansion-chamber or simple-cyclone type, and this collects the heavier particles. The overall dust-collection efficiency of the whole system is probably in the region of 40 per cent., when a simple cyclone is fitted and all the stack gases pass through the regenerator.

In most cases, hot-blast cupola installations seem to produce about the same amount of visible fume and smoke as an equivalent cold-blast installation, where combustion takes place above the charging door. However, cases have been reported of considerable fume density from hot-blast cupola stacks and recuperators. These reports are borne out by J. Prat,[22] who states that the amount of iron oxide emitted may be nearly double (about 18 lb. per ton of metal melted, as compared with some 10 lb.): The main reason for high fume outputs is probably a high proportion of steel scrap in the charge. There may, however, be other factors.

Further Comments on Spray- and Baffle-type Collectors

The efficiency of water-spray collectors depends on:—(1) The completeness of the spray curtain, *i.e.*, whether or not the gases can by-pass the spray at any point; (2) the degree to which the spray is broken up into droplets; and (3) the water flow. In considering (2), a successful design of spray nozzle is given in Fig. 7 (*e*).[27] Small droplets have the best chance of colliding with—and adhering to—small dust particles. If, however, the droplets

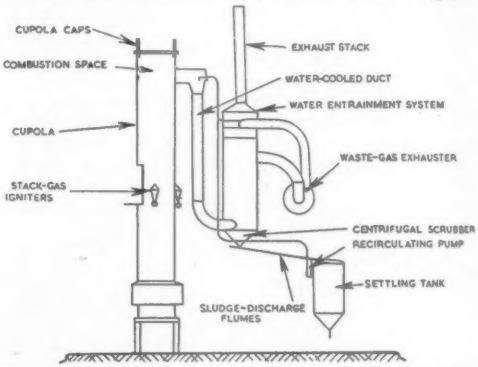


FIG. 8.—*Typical installation of a cupola equipped with a centrifugal scrubber for dust elimination.* (*D. E. Gilchrist.*)[24]

are too small, large water losses may be caused because of the droplets carried away by the effluent gas. Even without a nozzle of any sort, the baffle on which the water impinges can produce an efficient spray if the water hits it with a high enough velocity; this implies a high-pressure spray. When considering (3), the water flow, a reasonable minimum figure for this is 2½ to 3 times the weight of the air blown into the cupola, *e.g.*, water flow (galls. per min.) = 0.019 to 0.023 × blast (cub. ft. per min.).

The cone baffle has been dispensed with altogether, and a spray in the form of a cone used, which prevents water from dropping down the cupola stack[6] (see Fig. 7 (*d*)). There seems to be no advantage in doing this, as the collecting efficiency probably falls.[6] Various arrangements have been made for spraying water into the collector shell:—

(*a*) A water-spray nozzle (Fig. 7 (*e*).

(*b*) A hollow-cone baffle with the water coming

from small nozzles around the periphery[8] (Fig. 7 (*g*)). With this, some short-circuiting of the gases is likely, since the jets will probably not cover the complete cross-sectional area of the cupola stack.

(*c*) A hollow-cone baffle with the inlet at the periphery. Here, the water travels up the inside of the cone to an outlet in the apex and flows down the outside and off the periphery (Fig. 7 (*f*)). The water is thus present as a more-or-less solid curtain and can only be broken up by the gas flow; short-circuiting is therefore very likely.

(*d*) A spray ring around the inside of the collector shell throwing a water spray on to the baffle top (Fig. 7 (*h*)). Here again, the possibility of short-circuiting exists, as the jets are unlikely to overlap completely.

The single-spray nozzle appears to be the best means of introducing the water, since a complete spray-curtain is possible, and cleaning and replacement is facilitated by having only one nozzle.

Recirculation, Corrosion and Sludge Disposal

The water for a wet-collector either may be used once and thrown away or it can be recirculated. Some of the advantages of each system are enumerated as follows:—

Recirculation

(1) Less water required.

(2) Less water to be disposed of.

Non-recirculation

(1) Less corrosion of the system, since sulphur concentrations do not build up; alternatively,

(2) No acid neutralization required.

(3) The water is not highly polluted and may usually be put straight into the sewers.

Generally speaking, recirculation is the most economical unless unlimited cheap water and easy means of disposal are available. The water spray removes some 30 to 50 per cent. of the sulphur in the stack gases (as sulphur dioxide and soluble sulphates) and results in high concentrations in the water of recirculatory systems (168 parts SO_4 per 100,000 has been recorded after a five-hour blow). When recirculating, the concentration of SO_4 reached in a particular installation will depend primarily on the amount of water in the system per pound of coke charged throughout the blow, and the sulphur content of the coke. It also seems likely from the few figures available that increasing the water flow increases the sulphur pick-up (see Table I).

TABLE I.—*Sulphur Pick-up related to the Rate of Water Flow in Simple Wet Collectors.*

Collector.	Water flow lb. water per lb. of air blown.	Per cent. total coke sulphur removed by water (charge coke + bed coke).
Fig. 7(*c*)-type	2.6 (non-recirculated)	<4.3
Fig. 7(*a*)-type	4.3 (recirculated)	11.0
Fig. 7(*a*)-type	4.3 (recirculated)	12.1
Fig. 7(*a*)-type	27.0 (recirculated)	11.0
Fig. 7(*a*)-type	>30.0 (recirculated)	22.3

The rate of sulphur pick-up will not be reduced by the sulphur already present in recirculated water in the concentrations likely to be reached. The effect of the dissolved sulphur-dioxide, which ultimately forms sulphuric acid, is to cause serious corrosion of the whole installation, requiring frequent replacements if ordinary steel pipes are used.

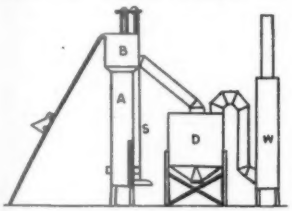


FIG. 9.—*Combined dry collector and washer arranged on a closed-top cupola.* (*Drake and Kennard.*)[6, 19] (*A*) *Cupola stack;* (*B*) *charging bell;* (*D*) *dry-dust collector;* (*W*) *wet washer; and* (*S*) *stockline indicator.*

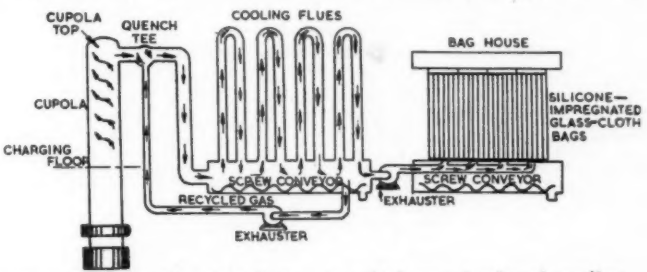


FIG. 10.—*Bag filter installation in which two banks of cooling flues precede the filters in the cycle of gas cleaning.* (*Siechart and Menardi.*)[13]

The rate of corrosion is accelerated by dust abrasion, especially at pipe elbows. Corrosion may be considerably reduced by neutralization with an alkali. Soda ash (sodium carbonate) is probably the most suitable neutralizer, though lime from an acetylene-generating plant has been used successfully, and reduced the iron in solution to a mere trace. One American plant[25] uses trisodium-phosphate to keep the pH value of the water between 6.5 and 7.0, the consumption being about 10 lb. per hr. for a cupola of 66-in. dia. lined.

Corrosion can also be reduced by using lined tanks and pipes, asbestos cement or earthenware pipes, stainless-steel baffles, *etc.*, where possible, but neutralization of the acidity of the water plus periodical replacement of pipework, *etc.*, is usually relied upon. The use of bronze (as opposed to unalloyed cast-iron) impellers is advisable for the pumps incorporated in such systems.

The wash water, whether recirculated or not, is normally returned to a settling tank where most of the dust which has been collected settles out.

G

Afterwards the water passes over a weir to a suction tank if recirculated, or to waste if not. The sludge in the settling tank can then be removed manually, or a chain bucket arrangement used. No commercial use has yet been found for the sludge, the results of three analyses (dry basis) of which are given in Table II.

TABLE II.—*Composition of Cupola Sludges, per cent. (dry basis)*

Loss on Ignition.	SiO_2	$Fe_2O_3 + Al_2O_3$	CaO	MgO	So_3	Remarks.
25.5	42.0	19.9	5.7	0.8	1.9	Sludge resulting during BCIRA test on spray- and baffle-type collector
32.4	20.3	11.1	25.9	1.0	2.0	Test carried out for BCIRA on sludge from Fig. 7 (*c*)-type collector
24.4	24.8	29.1 (Fe_2O_3 only)	—	—	—	See Reference 25

During a cupola " blow," water is lost by evaporation and splashing, and allowance must be made for this in the case of recirculating systems by periodical, or automatic, water additions. Evaporation accounts for some ¼ to ½ lb. loss of water per lb. of blown air, whether or not the water is originally hot at the spray-nozzle inlet. Settling-tank temperatures of 60 to 90 deg. C. have been observed; the final temperature reached depending on the rate at which heat is picked up in the collector and lost in the circulating system, being, therefore, ultimately independent of the amount of water in the system. The volume of water available, however, does affect the speed at which the maximum temperature is reached.

Design Recommendations:

A typical spray- and baffle-collector system for two cupolas is given in Fig. 7 (*l*) and design recommendations for this type include:—(1) To ensure freedom from blowing back at the cupola charging door, the top of the cupola stack should be 20 ft. or five times the lined diameter above the charging door top, whichever gives the greater figure. (2) There should be no reduction in lining diameter above the charging door. (3) At no point in the collector should the cross-sectional area of the gas path be less than 2½ to 3 times that of the lined stack. Table III, embodying the above recommendations, shows suitable dimensions for a range of collector sizes.

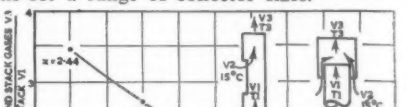


FIG. 11.—*Volume of mixed cupola-stack gases according to cold air induced through an open charging-door.*

Fume, Smoke and Gases

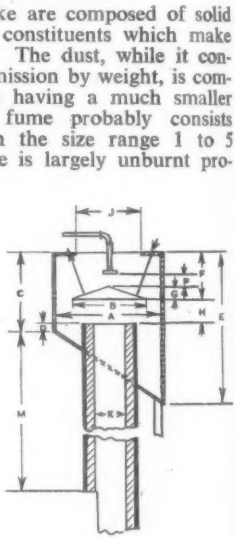
Cupola fume and smoke are composed of solid particles and it is these constituents which make cupola emissions visible. The dust, while it constitutes the bulk of the emission by weight, is composed of larger particles having a much smaller optical effect. Cupola fume probably consists mainly of iron oxide in the size range 1 to 5 microns, while the smoke is largely unburnt products from oily scrap, coke volatiles, *etc.*, and has a smaller particle size (say under 1 micron). Only the most-efficient collectors can therefore remove much of the fume; smoke, because of its even smaller particle size, is yet more difficult to collect.

Smoke composed of combustible materials can be burnt at the charging door if the requisite conditions are maintained at this point. These conditions are:

(1) *Gas temperature of about* 450 *deg. C.* If the existing temperature of gas at the charging door of the cupola is too low, it may be raised by increasing the coke:metal ratio and/or running the cupola with a lower charge-height. Both these recommen-

TABLE III.—*Recommended Dimensions of Spray- and Baffle-type Cupola Dust-collectors. (Dimensions required to give 2½ to 3 times Lined-shaft Area above Charging Door at any point.)*

Lined dia. above charging door (K).	Collector shell dia. (A).	Cone dia. B.	Baffle ring dia. (J)	Dimensions. H.	G.	P.	M.	D.	F.	C.	E.	Water consumption minimum gall. per min.
in.	ft. in.	ft. in.	ft. in.	ft. in.	in.	in.	ft.	ft. in.	ft. in.	ft. in.	ft. in.	
27	5 3	3 6	4 0	1 3	7	7	20	0 9	1 9	3 9	6 9	20
30	5 9	3 9	4 3	1 6	8	8	20	0 9	2 0	4 3	7 6	30
33	6 6	4 3	4 9	1 6	9	9	20	0 9	2 3	4 6	8 3	35
36	7 0	4 6	5 3	1 9	9	9	20	0 9	2 3	4 9	8 9	40
39	7 6	4 9	5 6	2 0	10	10	20	0 9	2 6	5 3	9 6	50
42	8 0	5 0	6 0	2 0	10	10	20	1 0	2 6	5 6	10 0	60
45	8 6	5 6	6 6	2 3	11	11	20	1 0	2 9	6 0	11 0	70
48	9 0	5 9	7 0	2 6	12	12	20	1 0	3 0	6 6	11 9	85
51	9 6	6 0	7 6	2 6	12	12	21	1 0	3 0	6 6	12 0	100
54	10 0	6 3	8 0	2 9	13	13	23	1 0	3 3	7 0	12 9	110
57	10 6	6 6	8 3	2 9	13	13	24	1 0	3 3	7 0	13 0	120
60	11 0	6 9	8 9	3 0	14	14	25	1 0	3 6	7 6	13 9	140
63	11 6	7 0	9 0	3 0	14	14	26	1 0	3 6	7 6	14 3	150
66	12 0	7 3	9 6	3 3	15	15	28	1 0	3 9	8 0	15 0	160
72	13 0	7 9	10 6	3 6	15	15	30	1 0	3 9	8 3	15 9	170



dations unfortunately decrease the thermal efficiency of the furnace to some extent. The use of a high bed will also increase the gas temperature[14], presumably because it has the same effect as a low charge height, *i.e.* the amount of charge volume between the melting zone and the top of the charge is reduced.

Gas burners may also be used at the charging door for increasing the gas temperature. This again reduces the overall thermal-efficiency of the furnace and it appears to be more simple and no more expensive to introduce the required heat by means of extra coke in the charge, as long as there is no metallurgical reason for not doing so. A gas burner, however, can be useful during the period at the beginning of the "blow," when the stack is cold, it can be turned off when flames appear naturally.

(2) *Sufficient intake of air at the charging door to provide oxygen for combustion.* The amount of air induced at the charging door depends upon the stack draught and the size of the charging door. If the recommendations given later for avoiding carbon-monoxide emissions on the charging platform are observed, they will also ensure that sufficient combustion air is induced.

Charging-door emissions

The stack draught in any cupola should be sufficient to produce a negative pressure at the charging door throughout the blow, especially when operators are employed on the charging platform. The draught, which depends on the height of the stack and the temperature of the gases, must be sufficient to overcome the resistance of the stack and any non-powered collector which is installed at its outlet. As previously suggested, to reduce stack resistance, the stack should be of constant diameter throughout its length. It should be not less than 15 ft. in height above the charging-door top, where no collector is used. This figure may seem excessive but it should be borne in mind that at the beginning of the blow the stack gases are cool and the necessary draught can then only be created by a high stack (assuming an induced draught fan cannot be used). Also, it is at the beginning of the blow that sufficient draught is essential, since it is then, before combustion of the carbon-monoxide has usually commenced, that charging-door emissions are likely to be the most dangerous.

The amount of carbon-monoxide in the stack gases (up to 16 per cent.) can easily produce lethal concentrations on the charging platform if any gases are discharged from the charging door. Of the other gases, there is none which will cause danger to the operators. The sulphur-dioxide, while present in fair quantity, has a pronounced smell (unlike carbon-monoxide, which is odourless) and is intolerable before it becomes dangerous.

Other factors which increase the possibility of charging-door emissions are: (1) Multiplicity of charging doors; (2) the cupola site—if the stack top is so placed that wind eddies tend to blow down it, then extra stack draught should be provided to overcome the wind pressure; and (3) a charging chute projecting into the shaft with a space between the underside of the chute and the sill, tends to deflect the rising gases out of the furnace. In one case at least, such an occurrence nearly led to a fatal accident. Where a fan-powered dust collector is used on a cupola with an open charging-door it is suggested that the fan capacity should ensure that a weight of air roughly equal to the cupola blown air weight is induced through the charging door.

Acknowledgments

The Author wishes to thank the director and Council of the British Cast Iron Research Association for permission to publish this Paper.

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Appendix A

Table of Actual Weights of Dust Collected by Various Types of Collector.

Reference or source.	Type of collector.	Weight collected, lb. per ton metal melted.
BCIRA ..	Dry-expansion, with induced air (Fig. 3 (*b*))	7.1 (Average of three tests)
BCIRA ..	Dry-expansion, with induced air (Fig. 3 (*b*))	12.3
BCIRA ..	Penthouse	10.8
4	Large expansion chamber, prior to washer	12.6–16.7*
2	Expansion chamber.. ..	17.2
21	Expansion chamber on cupola top	22–35 14.0 (Two installations)
7	Louvred cone	6.0
2	Expansion chamber and wet packed tower	13.0 (expansion chamber) 5.2 (wet, packed tower) Total 18.2 (Dust left in tower not determined)
BCIRA ..	Spray and baffle (Fig. 7 (*a*))	14.0 16.6 (Two tests, same installation)
BCIRA ..	Spray and baffle (Fig. 7 (*a*))	7.8
26	Spray and baffle (Fig. 7 (*a*))	16.0
BCIRA ..	Water-spray (Fig. 7 (*c*)) ..	22.3
20	Water-spray (Fig. 7 (*c*)) ..	11.2
10	Spray-chamber washer ..	7.4
13	Cooling-flue, hopper and bag filter	5.8 (cooling-flue hopper) 1.9 (bag filter) Total 7.7

NOTE.—The BCIRA figures given are for dry dust collected. In other cases it is assumed that the dust was dried before weighing.
* Lb. per ton metal charged.

Appendix B

Analysis of Dust from Cupola Penthouse (BCIRA Test).

B.S. Sieve No.	Size (microns)	Per cent. by weight.
+ 5	3,353	1.5
− 5 + 12	3,353—1,405	9.1
− 12 + 18	1,405—853	9.8
− 18 + 22	853—699	2.7
− 22 + 30	699—500	6.1
− 30 + 44	500—353	13.5
− 44 + 60	353—251	22.1
− 60 +100	251—152	22.4
−100 +150	152—104	9.0
−150 +200	104—76	1.8
−200	76	2.0

Analysis of Two Dust Samples from Expansion/Deflection Collector Fig. 3 (b) (BCIRA Test).

+ 60	251	77.8	81.0
− 60 +100	251—152	16.75	5.8
−100 +150	152—104	2.99	5.4
−150 +200	104—76	0.59	3.4
−200	76	1.63	4.4

Analysis of Dust from Louvred Cone (Fig. 6).

U.S. Standard Sieve No.	Size (microns).	Per cent. by weight.
+100	149	43
−100 +200	149—74	28
−200 +270	74—53	9
−270	53	20

Analyses of Dust Samples from Water-spray Collectors (Tests Carried out by or for BCIRA).

B.S. Sieve No.	Size (microns).	Per cent. by weight. A	B	C.
+ 5	3,353	3.7	6.6	9.5
− 5 + 18	3,353—853	12.8	4.9	24.6
− 18 + 22	853—699	5.6	2.8	6.8
− 22 + 30	699—500	4.5	4.1	16.3
− 40 + 44	500—353	6.3	7.1	14.3
− 44 + 60	353—251	8.7	8.8	8.7
− 60 +100	251—152	17.5	22.4	12.9
−100 +150	152—104	22.4	27.6	3.8
−150 +200	104—76	8.4	8.1	0.5
−200	76	10.1	7.7	2.6

and B: Dust samples from same collector type as in Fig. 7 (*a*).
C: A Dust sample from Fig. 7 (*c*) type.
NOT .—In all the above tests, some of the finer dust may have been generated during the sieve test itself.

Appendix C

Effect of cold air induced through an open charging-door or into a collector on the final volume of mixed air and stack gases (see Fig. 11).

Assuming: (1) Complete mixing of induced air and stack gases; (2) constant specific heat; (3) the same specific heat for air and stack gases (0.240); (4) induced air temperature 15 deg. C.; and (5) no combustion of carbon monoxide, then:

$$\frac{V_3}{V_1} = \left\{\left(\frac{T_1 + yT_2}{T_1\ (1+y)}\right) + y\left(\frac{T_2}{T_1}\right)\left(\frac{T_1 + yT_2}{T_2\ (1+y)}\right)\right\}$$

where T_1 is the gas temperature; T_2 the induced-air temperature; T_3 the temperature of mixed gas and air; V_1 the gas volume at T_1; V_2 the induced air volume at T_2; V_3 the volume of mixed gas and air at T_3; y = air dilution by weight (*e.g.*, lb. induced air per lb. of gas), or

$$\frac{\text{Air weight induced per unit time}}{\text{Gas weight passing up stack per unit time}}$$

x is the air dilution by volume (*e.g.*, cub. ft. of air per cub. ft. of gas, or

$$\frac{\text{Induced air volume } V_2 \text{ at } T_2 \text{ per unit time}}{\text{Gas volume } V_1 \text{ at } T_1 \text{ passing up stack per unit time}} = y\frac{(T_2)}{(T_1)}$$

Appendix D

A graphical representation of particle size-ranges of dust and fumes from cupolas, with approximate operating ranges of control equipment is shown in Fig. 12.

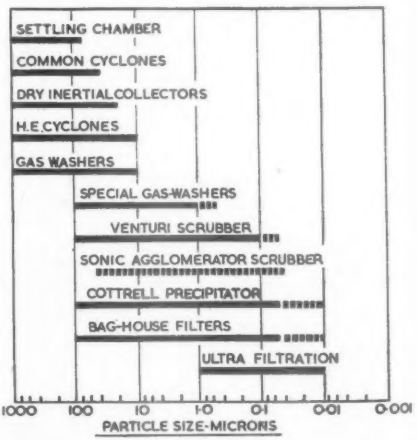

FIG. 12.—*Particle size-ranges of dust and fumes from cupolas . (Adapted from "Control of Emissions from Metal-melting Operations," AFS, 1955.)*

Key : ▬ cupola dust and ▮▮▮ cupola fume.

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(*Continued from page* 205).

Mould- and Core-bonding Agents

The routine laboratory examination of new mould- and core-bonding agents has continued. As a service to members, certain of the materials used in their foundries, *e.g.*, clays and raw sands, have also been tested in the Refractories Department of Sheffield University, whose assistance is gratefully acknowledged.

Two further bentonites, one Italian and one Spanish in origin, have been examined and a *Research Report* has been issued summarizing the properties of 52 bentonites and kaolinitic clays that have been examined since April, 1952, when the previous *Research Report* on this subject was issued.

A number of miscellaneous core-bonding agents have been examined in the laboratory; these include the "cold-setting" type of core binders which have found increasing application in foundries on the Continent. Three of the latter, two of Continental and one of British manufacture, have been examined. It has been suggested that these might find application in British steel foundries especially for purposes where cores need to be made to very accurate dimensions. Other core-binders examined include ammonia-based sulphite lyes and cereal/starch binders. Reports on all these products are contained in confidential *Committee Papers*.

Kaolinitic Clays

Following laboratory work in which it was suggested that sands bonded with bentonite/kaolinite clay mixtures have better foundry "life" properties than mixes bonded solely with bentonites, foundry trials have been carried out in a member foundry to determine if this prediction was correct. The foundry trials consisted of repeated casting tests and these confirmed that when a comparison is made on the basis of the percentage of green-strength retained after a given number of casting cycles, the straight kaolinitic-clay mixes and sands bonded with kaolinite/bentonite mixtures have better foundry "life" properties than have mixes bonded with bentonites only. On a similar basis, the tests also showed that Wyoming bentonite has better "life" than either a North African or British bentonite. Fig. 7 shows the results plotted on this basis while Figs. 8 and 9 showing the first and eighth test castings made in the sand bonded with the bentonite/ball-clay mixture illustrate the satisfactory surface quality of the castings.

Further and much more extensive foundry trials are to be carried out on the bentonite/kaolinite clay mixtures to determine if these preliminary findings are substantiated by repeated use over a long period of time under production conditions.

The repeated casting trials were also informative in allowing a comparison to be made between the foundry and laboratory tests for determining the "life" of clays. It would appear that the conditions of the laboratory test have a more deleterious effect on the bonding properties of the clays than has the foundry test. If "life" properties are to be adjudged solely on the deterioration in green-strength properties, then it may be said that some measure of agreement was obtained between the results given by the two methods of testing. If, however, the deterioration in dry-strength properties is used as a basis for comparison, the agreement obtained between the two tests is poor. Further work is, therefore, required before a rapid laboratory test can be formulated which gives a true and full measure of the "life" properties of clays in practical conditions.

The Association is grateful to Lake & Elliot Limited, for the provision of facilities for extended tests under foundry conditions.

Carbon-dioxide/Sodium Silicate Process for Hardening Moulds and Cores

The effect of the $Na_2O:SiO_2$ ratio and of the solids content of commercial sodium-silicates on CO_2 hardening has been investigated on behalf of the Association at Sheffield University. It has been established that the rate of hardening on gassing with CO_2 decreases with increasing alkalinity of the sodium-silicate, whereas variation in the solids content within the range of normal commercial silicates has comparatively little effect. With highly alkaline silicates, however, considerable further hardening takes place on standing after CO_2 treatment, whereas with the less alkaline silicates standing time has little effect. This increase in hardness with standing time of sands bonded with alkaline silicates may take place over a number of days and the final strengths reached may be very high.

The effects of organic additions, which are primarily intended to give increased collapsibility, on the bonding and bench life properties of sands bonded with commercial silicates have also been investigated. These additions consisted of sugars, both cane and syrup, and cereals, both starch and dextrine. They had little effect either on bonding properties or on the bench life of the silicate mixes. Determinations of the hot strengths of silicate-bonded sands show that the strength varies in a complex manner. In the range up to 800 deg. C., two strength peaks are observed, one at 250 deg. C. and one at 530 deg. C., both being followed by a rapid fall in strength. This behaviour is due to rapid loss of residual water and hardening of the bond in the range up to 260 deg. C. and from 360 to 590 deg. C. respectively, whilst the falls in strength occur when the rate of loss of moisture with temperature slows down and the bond softens.

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Further work on the hot-strength properties of silicate-bonded sands is in progress in which it is intended to determine what effect various organic additions have upon the rate of collapse at elevated temperatures.

Reclamation of Used CO_2-Process Sand

Initial trials have shown that it is possible by log washing to remove 75 per cent. of the alkali (Na_2O) present in a sand which has been used in the CO_2/silicate process. The removal of the alkali may have been still more complete if the used sand had been perfectly free from lumps of bonded sand. Bonding tests conducted on the reclaimed sand showed that whilst it had similar strength properties to new sand when bonded with clays, it was not satisfactory for re-use as core sand owing to its low strength when bonded with normal core binders. Limited foundry trials comparing the behaviour of the reclaimed sand and new sand when used in the CO_2/silicate process showed that casting strip from moulds made from the reclaimed sand was not as good as that from moulds made in new sand. This evidence, however, is not considered to be conclusive and much more extensive log washing and foundry trials are envisaged.

Data Sheets on Moulding Sands

As a guide to members and to fulfil a long standing need, the Association is compiling in the form of data sheets the main properties of available steelfoundry sands of British origin.

A search through the published literature has revealed little on the subject, but the Refractories Department of Sheffield University has made available a large amount of information on the properties of sands which have been examined there over the last 15 years. So far, some information on the properties of 70 different sands has been obtained, but much of this appertains to sands tested prior to 1946. In order to bring the information up to date the members of the Association's foundry practice and moulding materials committees have been invited to submit details of the properties of the raw sands they are at present using in their foundries and, if possible, to give some indication of the variation in properties with supply. The collaboration of certain suppliers of foundry sands has also been obtained in this project.

STEELMAKING

Oxygen Injection in Basic Electric Arc Furnaces

The Association has purchased a Honeywell-Brown pneumatic-type flowmeter fitted with an electronic integrator, and this has enabled the survey of oxygen injection practice in the works of member firms to be commenced with the object of determining the conditions leading to the most efficient use of oxygen in the steelmaking process. This apparatus is arranged so that there is no interference with any existing metering equipment and it can provide a check on such equipment.

There are some indications from the results so far obtained of considerable variations in oxygen consumption, inferring in some cases poor utilization and, indeed, probable waste of oxygen. Much variation of composition in the slag has also been found, the chief variable being the content of iron oxide, prior to the oxygen blow.

The results obtained to date have been considered by the Association's steelmaking committee through whose good offices offers have been received of further collaboration in experiments on production furnaces and of assistance with slag analyses.

It is proposed that the scope of this work on the injection of pure oxygen and of gases other than pure oxygen for carbon reduction should be extended to include the obtaining of data on the flushing of nitrogen and hydrogen gases from the bath, and the subsequent pick-up of these gases during the refining period and in the casting ladle. This proposal, which will necessitate the taking of samples for gas analysis, should provide data on the conditions likely to lead to the incidence of intergranular fracture, microporosity and other defects attributable to the nitrogen and hydrogen content of the steel.

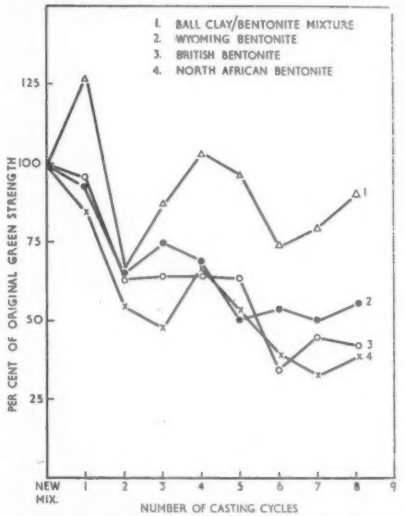


FIG. 7.—*In continuation of the Association's studies relative to the partial substitution of imported bentonites by indigenous ball clays, a series of repeated casting trials has been made to determine the relative foundry "life" of different clay-bonded sand mixes. The results of this comparatively short-term preliminary experiment are indicated by the curves which compare the percentage retained green-strengths of differently bonded mixes after a given number of casting cycles. On this basis, sands bonded with the kaolinite/bentonite clay mixtures are shown to have better "life" properties than those bonded with bentonites, and Wyoming bentonite is shown to be superior in this respect to North African or British bentonite.*

The Association's thanks are due to Professor J. White and to Dr. C. J. Dadswell through whose help slag analyses have been carried out in the Refractories Department of Sheffield University and in the laboratories of the English Steel Corporation, Limited.

Ladle Standardization

A standard on the design and construction of ladles for use in steel foundries has been prepared with the collaboration of the Association's plant engineering and steelmaking committees. This standard has been accepted by interested members of the Foundry Trades' Equipment & Supplies Association and is being circulated to members for their guidance.

Physical Chemistry of Steelmaking

With the object of drawing to the attention of members points of practical interest emerging from recent research of a theoretical nature, a survey has been made of the more recently published developments in the physical chemistry of steelmaking, with particular reference to the reactions involving carbon and phosphorus. Much of this published work refers to open-hearth furnace practice and comparatively little is based on data arising from electric arc furnace operation, which of course is more applicable to steelfoundry practice.

PLANT ENGINEERING

Air/Carbon-arc Torch

The Association's staff has continued to draw the attention of members to the possible wider use of this tool for dressing, in particular for the removal of defects on larger castings in plain carbon steel. It would appear that the shortage of dressers would encourage the application of the torch due to the fact that it removes the metal several times faster than the chisel.

Recent reports from the USA have indicated an extensive application of the torch in many steel foundries, with the consequent decrease in the number of pneumatic hammers used. There still exists, however, some uncertainty regarding the susceptibility of some grades of alloy steel to cracking when using the torch. Preliminary observations have been carried out on this subject as an introduction to a full investigation. To control the test conditions when gouging different steels a rig has been made, which will allow for the adjustment and maintenance of the speed of gouging, the angle at which the electrode is held to the work and the length of the arc.

Moulding-sand Compaction and Moulding Machines

Trials conducted on different types of British moulding machines and the data obtained on American moulding machines have not provided the information required for a valid comparison of the performance of British and American machines.

In the last year, at least two British moulding-machine manufacturers have placed on the market considerably improved machines, and the question whether the Association is justified in pursuing its investigations to include the purchase and import of American-type machines for the purpose of making strictly comparable trials have been reconsidered. In addition to seeking the advice of the foundry practice and plant engineering committees, the Association has obtained from several members comments on the relative performance of British and American moulding machines. The opinions expressed are equally divided regarding the superiority or otherwise of the American machines.

The experiments carried out in the past by the Association on the compaction of moulding sand have necessarily been under production conditions and, while leading to a more complete understanding of the problems and machine characteristics involved, they have not yielded very much basic information on the subject. Plans have been prepared for an investigation to obtain more detailed and fundamental data on the various factors affecting the compaction of moulding sands.

INDUSTRIAL HEALTH

Dust Control on Stand Grinders

The Association has filed a complete patent specification covering the original design of exhaust system together with the new feature of the roller workrest. Work has continued on the design of the latter and works trials (in conjunction with K. & L. Steelfounders & Engineers, Limited, whose help is gratefully acknowledged) are being carried out to assess the ability of the workrest to withstand normal foundry use.

A pedestal grinder made by F. E. Rowland & Company, Limited, incorporating all the BSCRA improvements has been tested in the Dust Research Station by HM Inspector of Factories. As a consequence of these tests HM Chief Inspector of Factories has instructed the staff of the Factory Department that they are to raise no objection to the BSCRA system in a steel foundry as compliance with Regulation 7(b) of the Iron & Steel Foundries Regulations 1953, provided each device is fitted with the roller workrest and is efficiently maintained. A sound film illustrating the development of this machine has been prepared.

Dust Control on Swing-frame Grinders

Experimental work has been completed on the combined integral and booth exhaust system which is the subject of a provisional patent. The exhaust rates required in the booth and in the motor-driven fan to give satisfactory dust control have been determined and the operation of the machine has been checked by observations with the Tyndall light beam and by dust counts. Extended foundry trials are now being made on this combined system.

HM Chief Inspector of Factories has instructed Inspectors that the BSCRA swing-frame grinder fitted with the integral exhaust system, when efficiently installed, maintained and worked, is acceptable as compliance with Regulation 1 of the Grinding of Metals (Miscellaneous Industries) Regulations and Regulation 7(b) of the Iron & Steel Foundries Regulations 1953. A sound film describing the integral and combined systems as

FIG. 8 (*upper*) *and* 9.—*The first and eighth castings produced in the sand bonded with 5 per cent. of a ball-clay/bentonite clay mixture in the repeated-casting trials referred to in* FIG. 7. *The surface finish of the casting (56 lb. total weight) produced in this sand was comparable to that obtained on castings made in bentonite-bonded sand mixes. The indications provided by this preliminary series of trials have encouraged the Association to plan a longer-term series using, if possible, a heavier casting.*

well as other methods for dust control for swing-frame grinders has been prepared.

Efficiency of Dust Collectors

The accumulation of data on different types of dust collectors has been continued and information on some equipment installed in members' foundries has been published. The Association is maintaining contacts with manufacturers of equipment and member firms conducting experiments on the suppression of fume resulting from oxygen injection in steelmaking.

Dust Control on Portable Fettling Tools

Studies have been made of the degree of dust control afforded by the Holman hollow-shaft chisel; the integrally-exhausted portable grinders in which the Dusductor principle of high-suction head, low-volume exhaust is employed, and the Holman rubber sleeve for pneumatic chisels. A ciné record has been made of the operation of the latter device.

Air-feed Mask

The prototype Mark III mask has been tested on behalf of the Factory Inspectorate by the Safety in Mines Research Establishment, whose report has recently been received. Some further work may be necessary to improve the efficiency of the mask at breathing rates corresponding to heavy working.

Dust-sampling Methods

Development of the long-term dust-sampling device now called the "Nephlet," in which the sample of dust is collected on an organic base filter, has continued and an investigation has been made of the possibility of using this in conjunction with a Spekker absorptiometer to provide a quick method of dust assessment based on the projected surface area of the dust sample collected by the instrument. It has been shown that this method has possibilities, but further attention is required to the design of the sampling instrument to ensure that it collects only particles of size less than 5 to 7μ. Comparative measurements have been made in a dust cloud of constant concentration in comparison with the Hexhlet sampling instrument.

Industrial Surveys

A large number of visits has been paid to member firms by BSCRA staff to advise on dust-control installations and to study new devices installed in members' foundries. Several measurements of dust concentrations in foundries have been carried out at the request of members.

(The Report is signed on behalf of the Council, by Mr. C. H. Kain, the chairman, and Dr. A. H. Sully, the director.)

More State Control Urged

A policy of wholesale nationalization of most sections of the engineering and shipbuilding industries was advocated on the third day of the annual conference of the Confederation of Shipbuilding and Engineering Unions at Hastings. Mr. R. W. Casasola, president of the Amalgamated Union of Foundry Workers, urged that State ownership of the two industries should be included in the policy statement now being prepared for next year's Labour Party conference. He wanted the confederation's "Plan for Engineering" to be the basis of talks with Labour Party leaders.

Mr. J. Matthews, industrial officer of the National Union of General and Municipal Workers, repudiated the suggestion that most aircraft manufacturers were inefficient. He pointed to the success of the Vickers Viscount which was being bought by almost every airline in the world, and the Bristol Britannia.

Referring to negotiations with the employers, Mr. E. J. Hill, secretary of the United Society of Boilermakers, Shipbuilders, and Structural Workers, complained that national organizations of employers were rejecting the unions' claims without examining the carefully prepared arguments in support of them. He said that he did not intend to continue going to such meetings only to be made ridiculous "by a bunch of rascals" and that the confederation should make an immediate protest.

On the last day of the conference exports and education were among the topics discussed. Mr. W. H. Bradley, of the Amalgamated Engineering Union, said that the coming of automation meant that Britain should drastically review her trade policies and secure for herself a reasonable share of the expanding markets of Asia. The conference adopted a motion welcoming the Government's White Paper on technical education, but calling for further measures to improve the supply and training of teachers as an essential for the future of the engineering industry. The motion called for an increase in the number and size of technical scholarships and for a halt in school-building economy cuts.

Iron-ore Imports

Iron-ore imports in July, and the total for the first seven months of this year compared with the corresponding period of 1955, are shown below.

Destination.	Month ended July 31.	Seven months ended July 31.	
	1956.	1955.	1956.
	Tons.	Tons.	Tons.
Sierra Leone	44,240	394,375	404,619
Canada	364,038	436,170	1,002,641
Other Commonwealth countries and Eire	80	8,097	10,081
Sweden	450,909	2,016,398	2,467,901
Norway	16,589	51,140	59,359
Western Germany	—	23,943	3,008
France	56,086	385,122	381,872
Portugal	6,850	55,491	74,593
Spain	78,598	466,724	532,470
Algeria	106,592	1,355,590	855,757
Tunisia	61,370	440,115	450,594
French Morocco	28,850	164,695	250,151
French West Africa	33,093	343,607	389,386
Spanish Morocco	18,010	124,255	167,171
Liberia	52,770	153,080	229,302
Brazil	40,510	287,732	314,236
Other foreign countries	88,394	78,548	384,100
TOTAL	1,446,979	6,785,082	7,077,241

Trade Union Views on Automation

A 14-page report on the approach of the trade unions to automation, prepared by the General Council of the Trades Union Congress for the annual congress at Brighton beginning on September 3 and published in the council's annual report, urges the avoidance of a "science fiction" attitude to the subject. The report welcomes the acceleration of technical development and calls for higher rates of capital investment by industry as well as for more attention to the education and training of technical and skilled personnel. The report comments: "In themselves, the shortage of scientists and technicians and inadequate supplies of equipment and materials are enough to retard any otherwise sensational and widespread development in the introduction of automation."

Because of these factors, the report continues, the extent of labour displacement is expected to be small. "To believe that automation will result in the social upheaval and misery caused by the Industrial Revolution of the 18th and 19th centuries when trade unionism was weak would indicate a lack of confidence in the trade union movement to protect its membership."

Redundancy problems, it is stated, can be met by prior consultation, by compensatory payments, and —if on a large scale—by Government aid to new industries in finding suitable locations. Price reductions instead of wage increases are then suggested as the desirable outcome of technical advance.

Levy for Iron and Steel Board's Funds

Last week, the Board of Trade announced that it has made an Order confirming a revised scheme for the provision of funds for the Iron and Steel Board, under Section 13 of the Iron and Steel Act, 1953. The scheme was submitted to the Board of Trade on June 29.

Under the Act, funds required to meet the expenditure of the Iron and Steel Board are provided by means of periodical contributions by iron and steel producers. Originally these contributions took the form of a levy on steel ingots of 4½d. a ton on each steel ingot over 1 ton in weight, and 4d. a ton for pig-iron other than that used for steel production. The new scheme will reduce these rates to 3d. and 2½d. respectively.

It is estimated that this will save the foundry industry something of the order of £12,000 a year.

The Order, the Iron and Steel Board Scheme for Provision of Funds Confirmation Order, 1956 (SI 1956 No. 1260), comes into effect on September 2, and will be on sale at the Stationery Office (price 3d.) on the following day.

Oil-equipment Orders

Orders received by British firms for oil equipment and materials in the first half of this year reached the record value of £74,772,900. This is £11,000,000 more than in the corresponding period last year. Figures for the second quarter, released by the Council of British Manufacturers of Petroleum Equipment, show that the value of contracts, at £36,282,900, is about £2,200,000 less than in the first quarter, when orders, however, are always exceptionally heavy.

The aggregate figure for the half-year included important orders for tubes, pipe fittings, and valves (£16,100,000), specialized drilling and production equipment (£7,400,000), tools and machinery (£5,000,000), and tankage (£4,500,000). Chemical companies received orders for the oil industry worth £12,670,000.

Pig-iron and Steel Production

Statistical Summary of June Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarizes activities during the past six months. Table II gives production of steel ingots and castings in June, and Table III, weekly average production of finished steel. Table IV gives the production of pig-iron and ferro-alloys in June, 1956, and furnaces in blast. (All figures weekly averages in thousands of tons.)

TABLE I.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index 1938 = 100.			Iron-ore output.	Imptd. ore used.	Coke to blast. furnaces.	Pig-iron ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy).			
	I. & S.	Coal.	Basic materials [1] (excl. fuel)						Imports. [2]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks. [3]
1953	260	350	506	304	207	237	215	188	17	339	262	962
1954	263	364	498	299	234	238	229	198	7	356	277	931
1955	276	399	529	311	244	246	240	213	29	381	305	1,183
1956—Jan. ..	285	436	537	328	278	270	261	222	38	405	337	1,208
Feb. [4] ..	285	437	538	315	284	269	263	226	37	418	332	1,220
Mar. ..	285	439	540	346	276	273	262	231	37	426	359	1,250
April ..	285	440	538	324	284	269	254	226	42	421	349	1,279
May [4] ..	297	433	541	306	274	255	247	213	29	396	321	1,306
June ..	300	461	539	302	256	252	240	209	27	380	—	1,315

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in June*, 1956.

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants and Essex ..	—	3.7	12.0 (basic)	2.6	0.1	16.9	1.5	18.4
Lancs. (excl. N.W. Coast), Denbigh, Flints, and Cheshire	1.2	28.1	—	2.3	0.4	30.6	1.4	32.0
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincolnshire	—	40.7	—	—	0.1	40.7	0.1	40.8
North-East Coast	0.9	74.4	—	1.5	0.5	75.2	2.1	77.3
Scotland	3.0	41.8	—	2.5	0.4	45.3	2.4	47.7
Staffs., Shrops., Worcs. and Warwick	—	19.7	—	1.4	0.7	19.8	2.0	21.8
S. Wales and Monmouthshire	5.8	67.4	6.9 (basic)	1.2	0.2	80.8	0.7	81.5
Sheffield (incl. small quantity in Manchester) ..	9.8	32.7	—	12.6	0.5	53.3	2.3	55.6
North-West Coast	0.1	1.7	2.3 (acid)	0.4	0.1	4.4	0.2	4.6
TOTAL	20.8	310.2	21.2	24.5	3.0	367.0	12.7	379.7
May, 1956 [4]	20.3	325.1	25.3	22.8	2.9	384.7	11.7	396.4
June, 1955 [4]	17.3	301.7	21.3	20.9	3.0	353.3	10.9	364.2

TABLE III.—*Production of New Non-alloy and Alloy Finished Steel.*

Product.	1954.	1955.	1956.		
			May.	April.	May. [4]
Non-alloy steel:					
Ingots, blooms, billets and slabs [5]	5.1	4.9	5.5	5.5	4.8
Heavy rails ..	9.6	9.4	10.8	11.9	9.8
Sleepers, fishplates and soleplates ..	1.9	2.0	1.2	2.0	1.8
Plates, ⅛ in. thick and over ..	47.0	46.1	50.0	55.0	49.3
Other heavy prod.	45.8	47.8	49.3	54.1	52.7
Ferro-con. rods etc.	5.9	7.0	8.0	8.4	7.0
Wire rods (incl. coiled rods, etc.)	19.7	22.2	23.4	25.8	24.0
Light rolled prod.	41.2	46.4	51.2	53.1	51.4
Bright steel bars ..	6.3	7.8	8.1	8.6	7.9
Hot-rolled strip ..	21.7	24.1	25.4	25.9	25.1
Cold-rolled strip ..	7.0	8.1	8.6	8.3	7.8
Sheets (incl. coated)	38.8	42.7	45.7	44.7	39.1
Tin, terneplate and blackplate	16.8	17.0	16.8	17.6	17.8
Steel tubes, pipes	20.0	22.9	25.5	25.7	27.5
Tube, pipe fitgs ..	0.4	0.4	0.5	0.6	0.4
Tyres, wheels and axles	4.7	4.8	4.9	5.5	4.6
Forgings (excl. drop forgings) ..	2.6	2.5	2.7	2.9	3.0
Steel castings ..	4.0	4.2	4.3	4.5	4.5
Tool and magnet steel	0.2	0.3	0.4	0.3	0.3
Total	298.7	320.6	342.3	360.4	338.8
Alloy steel	13.2	15.3	16.0	17.6	17.2
Total deliveries from U.K. prod. [6] ..	311.9	335.9	358.3	378.0	356.0
Add: Imported finished steel ..	5.0	18.8	17.8	29.1	19.2
	316.9	354.7	376.1	407.1	375.2
Deduct: Intra-industry conversion [7] ..	41.5	50.4	53.1	58.9	55.7
Total of new material	275.4	304.3	323.0	348.2	319.5

TABLE IV.— *Production of Pig-iron and Ferro-alloys during June* 1956.

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	26	2.2	23.0	19.7	1.1	—	46.0
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire ..	7	—	12.8	—	—	1.6	14.4
Yorkshire (excl. N.E. Coast and Sheffield) ..							
Lincolnshire ..	10	—	32.3	—	—	—	32.3
North-East Coast	21	4.5	48.5	—	—	0.8	53.8
Scotland ..	9	0.8	15.7	1.2	—	—	17.7
Staffs., Shrops., Worcs., and Warwick ..	7	—	9.6	1.5	—	—	11.1
S. Wales and Monmouthshire	9	3.4	36.4	—	—	—	39.8
Sheffield	2	—	3.3	—	—	—	3.3
North-West Coast	9	19.8	—	0.2	—	1.2	21.2
Total ..	100	30.7	181.6	22.6	1.1	3.6	239.6
May, 1956 [4] ..	100	29.5	188.0	24.5	0.8	3.7	246.5
June, 1955 [4] ..	96	21.0	162.6	28.1	1.0	4.1	216.8

[1] Used in non-food manufacturing industry.
[2] Weekly average of calendar month.
[3] Stocks, mainly ingots and semi-finished, at the end of the years and months shown.
[4] Five weeks, all tables.
[5] Other than for conversion into any other form of finished steel listed
[6] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel
[7] Material for conversion into other products also listed in this table.

Establishing a New Foundry

By Frank Warga

In order to obtain first-quality castings at reasonable prices, AiResearch Manufacturing Company, of Los Angeles, has twice been compelled to acquire complete foundry facilities. The initial foundry (which is still in operation) was established in 1946 for the purpose of producing aluminium sand castings. The second foundry began producing ferrous castings on December 16, 1952. It was believed in establishing the latter unit that the experience gained in casting non-ferrous alloys would be of much practical value. This proved to be slightly optimistic. However, the management did enjoy some of the advantages of the tyro who —being unaware of what could not be done—went blindly ahead and accomplished the impossible.

At the time of writing, the ferrous foundry provides employment for 16 men in 60 ft. by 120 ft. of plant space; and, in a period of three years, has* produced over 100,000 acceptable castings from a total of 209 tons poured. While these figures do not by any means represent what it is thought should (and will) be the optimum level of productivity, they do indicate that the early operations have been pleasingly profitable.

Range and Objectives

Most of the ferrous casting work involves the production of relatively-small, thin-walled articles with weights ranging from 2 oz. to 7 lb. They comprise Armco 17-4 (precipitation hardening alloys), Ni-Resist (types 1 and 2), and virtually all stainless-steel alloys. The ultimate objective in producing these casts is to provide the company with components that will be so perfect in the "as-cast" condition that they will require no machining whatsoever prior to use. This goal may never be attained, but the efforts made to date have yielded "as-cast" components that were dimensionally accurate within plus-minus 0.10 in. tolerances and consistently capable of meeting the requirements of Government specifications for X-ray testing.

Equipment

In the procurement of equipment for the ferrous foundry, the management has been especially careful to avoid the purchase of heating facilities that could not be operated in conformity with local "smog control" ordinances—enforcement of which has led to the bankruptcy of several foundries in the Los Angeles area during recent years. Consequently, the department is now making satisfactory use of:

(a) Two 150-lb. capacity induction furnaces (one of which is a standby unit) for melting Armco and stainless-steel alloys (with pouring temperatures in the neighbourhood of 1,650 deg. C. (Fig. 1).

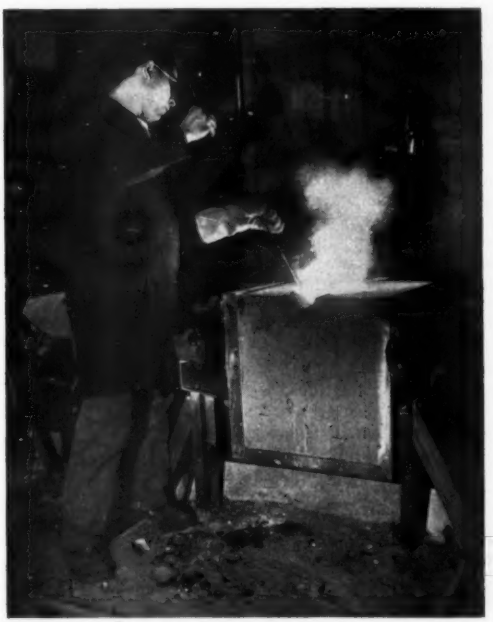
(b) A 450-lb. capacity Detroit rocking-arc furnace for melting Ni-Resist alloys (with pouring temperatures of about 1,556 deg. C).

No smoke-precipitation or filter equipment has been required to avoid atmospheric pollution in operating any of these melting units.

Although a new patternshop is now being operated as part of the ferrous foundry, it has been found that the same types of wooden and metal patterns that are used to produce moulds for casting aluminium will meet the present ferrous foundry requirements. In fact, the management frequently balances the work load in the two patternshops by having some "masters" for aluminium made by the non-ferrous patternmakers—and *vice versa*.

In the fabrication of cores, the shop is now making satisfactory use of extra-fine core sands and oil-type binding media. However, it is hoped that a current series of tests will allow of better results by using synthetic corebinders. An oven with a capacity of 5½ cwt. is used for baking cores. (Fig. 2.)

FIG. 1.—*Induction melting furnace—just after the alloy addition—in preparation for a cast of stainless steel at the foundry of AiResearch Manufacturing Company, Los Angeles.*



* The Author is general foreman, ferrous and non-ferrous foundries of AiResearch Manufacturing Company, Los Angeles, California.

FIG. 2.—*Unloading the core-drying oven at the steel foundry of AiResearch Manufacturing Company. The oven has a capacity of 5½ cwts., and can be brought up to temperature (260 deg. C.) within 20 min.*

FIG. 3.—*Knocking-out sand moulds at the California foundry. The casting is a stainless-steel flapper-valve plate, for a high-temperature air valve.*

The firm has been tempted to make use of investment moulds in producing a number of ferrous casts. However, experience has clearly shown that any advantages that might thus be gained in terms of quality would have been greatly exceeded by the disadvantages of higher production costs. Therefore, exclusive use is made of shell and dry-sand moulds. Most of these moulds are manually fabricated. However, it has been found practical to accelerate a few mould-making operations by the employment of a small rollover machine.

Other Facilities

For domestic purposes, it is felt that the cost of shell moulds (made with phenolic resins) can be justified only by improvements in the quality of stainless-steel castings. In this connection, there seems every chance that further improvements can be economically attained through the eventual use of ceramic moulds.

Complete sand-control laboratory facilities have enabled the staff to eliminate most of the mould-making difficulties encountered during the initial weeks of the ferrous foundry operation. Silicone release agents are being used to prevent the adhesion of mould and pattern materials and casein-type adhesives are being used to assemble both shell and dry-sand moulds in order to minimize the quantities of alloys that are wasted when casts are made. The moulds are manually filled by means of ladles preheated so as to maintain the required pouring temperatures for the various casting alloys.

After knockout (Fig. 3), grinding, shot-peening, and shot-blasting facilities are used to clean "as-cast" components. Then, before the parts leave the ferrous foundry, they are annealed. The annealed castings are sent to a subcontractor's laboratory for X-ray inspection. Then they are taken to the main plant where they are machine-finished, plated or coated (as necessary), and assembled.

One of the most serious problems encountered in ferrous foundrywork is the matter of gating, because the management was initially under the impression that certain cut-and-dried rules could be employed in making each and every mould. It is now convinced that the only satisfactory way to gate a mould for ferrous castings is to exercise a liberal amount of commonsense in preparing for each new project. Most of the metallurgical headaches associated with ferrous casting operations have been avoided by purchasing pre-alloyed metals, and by making constant use of a rapid carbon determinator. However, it is now being found that it is both economical and practical to prepare alloys on the spot for experimental work and small-scale production operations.

NEVILLE FOUNDRIES, LIMITED, are to be transferred from The Holmes, Rotherham, where they were established in 1917, to a new foundry now in the course of construction at Sleaford, Lincolnshire. Some of the personnel will be transferred. Mr. G. M. Andrews, the managing director, has been with the firm since its establishment.

THE National Society of Master Patternmakers (secretaries: Fisher and Firkins, 12, Cherry Street, Birmingham) has issued its programme of activities for 1956 to 1957. It is a very attractive fixture list, with meetings in London, Chippenham, Birmingham, Coventry, Manchester and Leicester. A few copies are available on writing to the secretaries.

New Telcon Factory at Crawley

Production of Special Alloys and Magnetic Materials

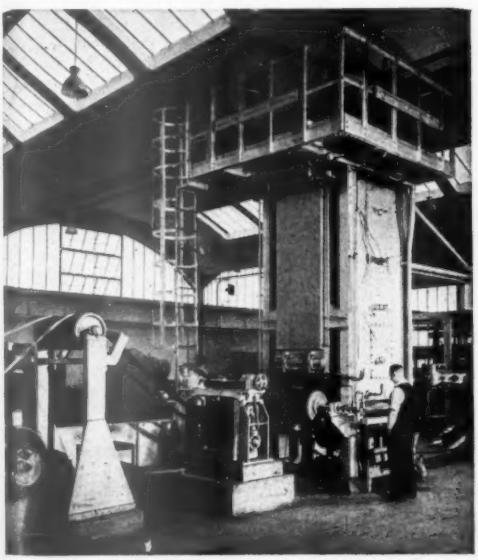
The metals division of the Telegraph Construction & Maintenance Company, Limited, has moved recently to the new factory at Telcon Works, Manor Royal, Crawley, Sussex. The works are situated on a site of approximately ten acres of which about 100,000 sq. ft. is devoted to factory space and 20,000 sq. ft. to offices and research laboratories. About 20 different alloys are produced in the works, more than half of which are various magnetic materials. The main plant at the factory includes the following:—

The main melting plant, which consists of ½-ton and ¼-ton induction furnaces, together with a ¼-ton vacuum melting furnace, all of which are operated from motor-generator equipment. Beryllium copper melting is to be located in a separate building soon.

The cogging mill, which is equipped to take rolls for producing basically, either 6-in. or 2-in. slabs for strip, or 1¼-in. squares for rod rolling and wire. The main plan for strip production is to operate on square ingots weighing about 340 lb. each, cogging them down and subsequently rolling them in the 3-high hot strip mill.

Pickling and Continuous Annealing Plant.—The long strips are passed through a continuous descaling bath and scratched-brushed to remove all scale and surface imperfections. They are then transferred laterally on to a conveyor for the continuous annealing furnace, after which they are ready for breaking down by cold rolling into thinner gauges.

FIG. 1.—*Continuous heat-treatment plant at the Telegraph Construction & Maintenance Company's new factory at Crawley.*



Breaking-down Mills.—Hot-rolled strip is broken down on 4-high mills and given intermediate annealings in suitable furnaces and atmospheres. The finishing is achieved by a batch of cold rolling mills of various types which reduce the alloys to the desired dimensions. The electronically controlled Sendzimir mill gives a range of 0.020-in. down to 0.0006-in., handling strip 6-in. wide and giving close tolerance on thickness. The operation of this mill is complicated and involves precision grinding of roll cambers which is carried out in the roll grinding shop. A battery of slitters is available for cutting the strip to widths making it suitable for the production of laminations, cores, etc.

Rod Section and Wire Drawing.—For the common types of rod and wire, material in the form of 1¼-in. squares received from the cogging mill, is handled on the rod and bar rolling mill. Here the most common output size is $\frac{5}{16}$-in. dia., but the mill can handle a wide variety of certain sections.

Beryllium-copper Alloys.—Apart from a large output of strip of various thicknesses, this company specializes in the production of beryllium-copper non-sparking tools and castings, and it is equipped with production facilities for making about 400 different types of tools.

Core-making.—A section of the side bays is devoted to the manufacture of all sizes of cores in Mumetal, H.C.R. and thin Radiometal, mainly for the electrical industry.

A section is also devoted to special heat-treatment (Fig. 1). Another bay is engaged on the production of a wide variety of Mumetal screens in the form of hand-fabricated parts and pressings.

Inspection and Control.—All materials are sampled in the ingot stage and approved on chemical analysis before processing begins. In their final forms, they pass through the inspection section where they are examined for surface defects, magnetic properties, etc.

New Procedure for Rebuilding O.H. Furnaces

A new idea in open-hearth construction when replacing a furnace is to build the structural steel framework outside the open-hearth building, and move it into place as a unit rather than piece by piece or in sections, as has been the general practice hitherto. It has been done at the Geneva Works of US Steel's Columbia-Geneva Steel Division to expedite a rebuilding programme and reduce the amount of furnace "down time," states *Blast Furnace and Steel Plant,* May, 1956. This method enables the furnace framework to be constructed without interference with the production of steel from other units, and also allows the old furnace to be kept in production for the longest possible time. An experimental rebuilding job on these lines was completed in 15 days. It took eight days to demolish the old furnace and to make the site ready for the new prefabricated structure, which weighed 475 tons. Seven days after it was moved into place, the new furnace was complete with refractories and ready for the hearth bottom to be rammed. A saving of approximately 15 days was effected, compared with conventional rebuilding of a furnace.

Company News

PULSOMETER ENGINEERING COMPANY, LIMITED—In declaring a 10 per cent. interim dividend on £560,000 ordinary in respect of 1956, the directors further advise shareholders that in the absence of unforeseen circumstances they expect to recommend a further 10 per cent. for the year.

BIRFIELD, LIMITED, manufacturers of general engineering supplies, of London, W.1—Sales in the three months to May 31 amounted to £4,330,000 (£4,186,000 in the corresponding period of 1955) and in the nine months to that date £12,769,000 (£10,915,000). The net trading surplus for the three months to May 31 is £403,000 (£444,000) and for the nine-month period £1,288,000 (£1,246,000). The surplus is calculated after providing for depreciation but before taxation.

HALESOWEN STEEL COMPANY, LIMITED—As indicated in April with the 1955 accounts, the board is reducing the difference between interim and final dividends with an increased interim payment on account of the current year. The declaration now announced is 4 per cent., against 2½ per cent. a year ago. The directors again point out that this increase does not imply a larger total for 1956 than the 12 per cent. paid for the previous year. The 1954 total was 10 per cent.

KIRKSTALL FORGE ENGINEERING, LIMITED—Turnover for the year ended June 30 was a record, at £4,250,000. Trading profits advanced to £538,258 (from £451,032), in spite of a lower margin of profit. During the year £278,000 was spent on new plant and buildings and on the purchase of three acres of land adjoining the works for future extensions. Commitments for new plant and buildings are £313,000 (£332,000), which the board feels can be financed from existing resources. Because of this and the need to plough back profits the ordinary dividend is unchanged at 12½ per cent.

GEORGE KENT, LIMITED—The value of the company's output increased by 16 per cent. in the year ended March 26 last, partly due to the volume of steering gears for motor vehicles which was maintained at a record level until the end of the financial year. Since then, adds Cmdr. P. W. Kent, chairman, there has been an inevitable decline in common with fortunes of the motor trade. Production of mechanical water meters meant running the Luton works to capacity. Orders continue to back output, of which some 90 per cent. is for export. The overall total of orders obtained during the year, other than steering gears, rose by 26 per cent. Home orders increased by 21 per cent., and exports by 32 per cent., the respective totals being £1,765,000 and £1,435,000.

EDGAR ALLEN & COMPANY, LIMITED, steelmakers and engineers, of Sheffield—For the past 10 years the accounts of the company have reflected, in terms of total sales, values, and profits, "a high and sustained level of trading activity." This sequence has now been broken, says the chairman, Mr. W. H. Higginbotham. For the year ended March 31 last, while activities of the parent and its seven subsidiaries have been, on the whole, well maintained, the trading profit, after tax, has declined sharply. Nevertheless, orders on hand are much greater both in volume and value than at this time last year, with increases in all the major departments. It is reasonable to expect that, if there is no serious wage increase, the trading results for 1956-57 will be substantially better than 1955-1956.

THE MEXICAN STEEL INDUSTRY will hold its second national congress in Vera Cruz from March 17-21, 1957.

New Patents

(Copies of complete specifications are obtainable from the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

751,987. Gebr. Bohler and Company, A.G., Elisabethstrasse, 4, Vienna, 1, Austria.

Centrifugal casting mould formed of an alloy steel. It consists of carbon 0.05 to 0.5, manganese 0.3 to 0.6, silicon 1 to 1.5, chromium 1.7 to 2.6, molybdenum 0.2 to 0.5 and vanadium 0.2 to 0.5 per cent. Up to 1 per cent. of tungsten, titanium, tantalum or niobium may be added. The rest is iron with usual sulphur and phosphorus impurities.

752,117. R. A. Long, 24426 Bruce Road, Bay Village, Cuyahoga County, Ohio, USA.

An alloy for bonding together titanium-base metals and other metals or alloys to provide a joint having high tensile-strength and high shear-strength at room and elevated temperatures. It consists (by weight) of at least 65 per cent. of a binary alloy of nickel 66 to 70 and titanium 34 to 30 per cent., the balance, if any, consisting of a copper group metal.

752,124. Universal Cyclops Steel Corporation, Bridgeville, Penns., USA.

An alloy steel of high loading ability at elevated temperatures. It contains carbon 0.28 to 0.35, manganese 0.75 to 1.5, silicon 0.30 to 0.80, chromium 18.0 to 21.0, nickel 8.0 to 11.0, molybdenum 1.0 to 2.0, tungsten 1.0 to 2.0, titanium 0.40 to 0.90, sulphur 0.40 maximum, and phosphorus 0.20 maximum per cent. The balance, apart from incidental impurities, being all iron.

752,168. Meehanite Metal Corporation, 714 North Avenue, New Rochelle, N.Y., USA.

A process for the production of cast iron. The charge composition with respect to graphitic carbon content and carbon equivalent is adjusted so as to give a defined constitutional value. The charge is then melted, and the melt graphitized with an agent consisting of a mixture of a silicon alloy (*e.g.*, barium silicon or strontium silicon, or ferro-silicon, zirconium silicon, titanium, nickel or manganese silicon) and a metal fluoride.

752,271. Irving Rossi, 40 Wall Street, New York, 5, N.Y., USA.

A mould for the continuous casting of metals and more particularly of steel, of the type which comprises a vertical passage for the cast piece. One or more of the induction coil or coils are provided at the level of the mould, and so energized that the still-molten metal of the cast piece tends to flow up along the axis of the mould and flow down near the inner axis of the mould.

752,273. Solvay and Cie, 33 rue Prince Albert, Brussels, Belgium.

A method of preparing an alloy of lead and one or more alkali metals from an amalgam of mercury with the alkali metal or metals. Lead is dissolved in the amalgam to form a composite lead/alkali metal amalgam. The mercury is then eliminated by distillation.

EIGHTY WORKERS at the Grantham works of the Ransome & Marles Bearing Company, Limited, have been declared redundant because of a fall in demand for components by the motor-car industry. At the company's Newark works, 400 employees were recently put on a four-day week.

New Catalogues

Cold-setting Corebinder.—Recently the Fordath Engineering Company, Limited, Albion Road, West Bromwich, acquired a sole manufacturing licence from Oel-Chemie of Switzerland, for a cold-setting corebinder. This has now been named "Glyso-Corovit." The company has issued a folder which outlines the conditions where the use of the new material is specially favourable—that is for heavy and complicated cores. Then follow instructions for use, and herein is included a graph indicating the application of an accelerator as a time-saver. The pamphlet certainly makes interesting reading. Finally, there is a testimonial from a Scottish foundry. There is printed the far-too-common error of AFA instead of AFS. This folder is available to readers on writing to West Bromwich.

Thermal Engineering. Using this ubiquitous title, the Incandescent Heat Company, Limited, Cornwall Road, Smethwick, Birmingham, have issued a brochure with a fully illustrated description of their widespread activities. In it, naturally, there are many references to foundry installations of cupolas and electric furnaces. There seems to have been no fixed policy for indicating just where these plants have been installed, but installations abroad quite often come in for mention. The brochure runs to 34 pages and is more than generously illustrated. It is available to readers on writing to the Smethwick works.

Diamond Abrasive Wheels. Norton Grinding Wheel Company, Limited, Welwyn Garden City, are sending to their customers a three-page folder cut out to form the shape of an old-fashioned weather forecaster, wherein either a man prepared for rain or a woman clothed for sunshine comes out from a hut. It is of the type meant to arouse sufficient interest to induce one to dispatch a card asking for more detailed information. For that particular type of appeal it is quite good, especially as the object is to publicize the query as to when and where one should use dry or wet grinding.

Twin-rail Overhead Chain Conveyors. Geo. W. King Limited, Stevenage, Herts, have just issued a 36-page well-illustrated catalogue covering their "Dual Duty," twin-rail overhead chain conveyor, whereby the chain draws a trolley carrying the load, and thereby itself carries no load. The catalogue gives a quantity of clearly-set-out data and many pictures are given of actual installations. Readers may avail themselves of the catalogue by writing to Stevenage.

Fume-removal Fans. In publication No. 33, Keith Blackman, Limited, Mill Mead Road, London, N.17, illustrate and describe, using very clear pictures, two types of "Tornado" p.v.c. fans. The first series is direct motor driven and the second indirect motor driven. Both series are designed to handle fumes from chemicals. The two ranges cover ten models. The leaflet may be obtained by writing to Mill Mead Road.

Aluminium Die-castings. The Northern Diecasting Company, Limited, Norcastle Works, Burnley, Lancs, have submitted a folder which illustrates and describes a range of castings used by a variety of industries.

Publications Received

European Steel Market in 1955. Published by the United Nations. Obtainable from the Sales Section, Palais des Nations, Geneva. Price 5s. 6d.

One learns from Table 1 that in Europe steel castings are bought in the following proportions: Permanent construction (to include mining, railways, building and contracting and constructional engineering) 20 per cent.; manufacture and repair of transport equipment (to include shipbuilding, railway and tramway equipment, motor vehicles, cycles and aircraft) 23 per cent.; manufacture of machinery (except electrical) 46 per cent.; manufacture of electrical machinery 4 per cent. Seven per cent. is absorbed by other consumers.

The production of iron castings in Europe has grown from 12.7 million tons in 1913, through 13.8 in 1937 and 13.9 in 1950 to 18.6 million tons in 1955. Corresponding figures for scrap consumption by foundries has risen from being about half the charge in 1933 to a little under two-thirds in 1955. These are the only figures the reviewer found of interest to the foundry industry, but for makers and consumers of wrought steel, there is a wealth of information contained in the hundred-odd pages of the survey.

List of Members (May 1956). Published by the Purchasing Officers Association, Wardrobe Court, 146a, Queen Victoria Street, London, E.C.4; price 10s. 6d.

This 136-page book, intelligently used, can be of great value to the sales department of any industrial concern as it is so arranged that the purchasing officers of a few thousand companies can be located by name. Against the name of each firm is listed the nature of their business, and it is not difficult to extract therefrom a list of potential customers. This is so much better a system than "paying court" to a firm's commissionaire.

Nickel Bulletin, July, Vol. 29, No. 7. Published by the Mond Nickel Company Limited, Thames House, Millbank, London, S.W.1.

The increasingly close inter-relation of metallurgy and the development of atomic energy is demonstrated by the literature abstracted in this issue of the Bulletin, which includes reference to papers presented at a symposium on metallurgy in the nuclear-power field and to items of metallurgical interest in a volume of the proceedings of the International Conference on the Peaceful Uses of Atomic Energy. High-temperature engineering in the aircraft gas-turbine and related fields is represented by a series of papers dealing with the properties of metallic materials for use at temperatures above 870 deg. C.

Kodak School of Industrial and Engineering Radiology. Issued by Kodak, Limited, Victoria Road, Ruislip, Middlesex.

It is claimed that the Kodak School of Industrial and Engineering Radiology is the only *locale* in this country where courses are available for the teaching of industrial radiology. Moreover, one course is approved by Lloyds. In this "prospectus," the various courses are listed together with the tuition and examination fees. It is available to readers on writing to Ruislip.

THE Steetley Magnesite Company, Limited, announces that it is expanding its Hartlepool works at a cost of £1,250,000. Production will be increased by 40 per cent. to meet the growing demand of the steel industry.

Personal

Mr. F. PICKWORTH, chairman of English Steel Corporation, Limited, has joined the board of English Drilling Equipment Company, Limited, as chairman.

Mr. A. W. WALDRIDGE, erection superintendent of Ransomes & Rapier, Limited, engineers and ironfounders, etc., of Ipswich, has retired after 45 years' service with the firm.

A presentation was made at Park Works, Lockwood, Huddersfield, last Friday, of two farewell gifts to Mr. ALBERT BIRDSALL, on his retirement after 41 years' service with the David Brown group.

Mr. J. LEAVER has been appointed to the board of the Parkinson Stove Company, Limited, and Monitor Engineering and Oil Appliances, Limited, both subsidiaries of the Parkinson and Cowan group of companies.

Dr. H. W. MELVILLE, F.R.S., took up his appointment as secretary of the Department of Scientific and Industrial Research on August 27, and Dr. G. B. B. M. SUTHERLAND, F.R.S., takes up his directorship of the National Physical Laboratory on September 14.

Caterpillar Tractor Company, Limited, announce that with the acquisition of the Birtley Company, Limited's factory, Col. R. T. EDWARDS, formerly managing director of that company, remains as manager and also becomes a member of the board of directors of the Caterpillar concern.

General Refractories, Limited, have awarded a Post-Graduate Bursary for two to three years at Sheffield University to Mr. P. G. SMITH, B.SC. (Tech), who will, under the direction of Professor Thring, undertake work on "Heat Transfer and Fluid Flow in Combustion-heated Refractory Firing Kilns."

Mr. C. C. TULLEY, a research assistant in the furnace department of the British Coal Utilization Research Association, has been awarded a special prize from the James Clayton Trust Fund of the Institution of Mechanical Engineers for his outstanding performance in the higher national certificate examination.

Sir PATRICK BRANIGAN, QC, who became a member of the Industrial Disputes Tribunal last year, is to be chairman of the Commission of Inquiry set up by the Northern Rhodesia Government to deal with the current Copperbelt industrial unrest. Sir Patrick was chairman of the Conciliation Board set up in connection with the Copperbelt strike in 1940.

Mr. J. G. WISTREICH, who has been head of the metal working laboratory of the British Iron and Steel Research Association at Hoyle Street, will become head of the mechanized working division as Mr. W. C. F. HESSENBERG, deputy director of BISRA, is to relinquish control of the division in order to devote the whole of his time to his other duties. Mr. S. S. CARLISLE, head of the BISRA South Wales laboratories, becomes deputy head of the division.

To mark his retirement, Mr. FRANK ANGELL, deputy chief engineer at Hadfields, Limited, steel manufacturers and engineers, Sheffield, received a presentation from his colleagues on August 23. He was appointed in 1948 to the works reorganization section and had a responsible part in the engineering work then going on at the Hecla and East Hecla Works. Later he took charge of the works engineering department.

The S. Laurence Gill prize for first place in the final examination of the Institute of Cost and Works Accountants has been awarded to Mr. ANTHONY E. R. WATKINS, aged 31, an office-methods adviser with K. & L. Steelfounders and Engineers, Limited, Letchworth. Of the 1,455 candidates who sat for the whole or part of the final examination in June, 965 failed, 225 passed the complete examination, 61 passed part A only, and 204 passed part B only.

Mr. J. J. GRACIE has relinquished the chairmanship of the Greater Birmingham Employment Committee, which he has held for the past nine years, owing to pressure of other business. He is a director of the General Electric Company, Limited, J. T. Rothwell & Company, Limited, manufacturers of steel tanks, etc., of Accrington (Lancs), and Coldair, Limited, Wembley, another subsidiary of the GEC. Mr. Gracie is also chairman of Parkhall Pottery, Limited.

Mr. F. W. MARTIN has been appointed deputy chairman of the Simplex Electric Company, Limited, a subsidiary of Tube Investments, Limited. Mr. Martin, who is deputy chairman of Tube Products, Limited, of Oldbury, was recently appointed deputy chairman of the Power Centre Company, Limited, and has been a director of Simplex Electric and Mersey Cables for many years. Mr. E. G. PLUCKNETT, a director and general manager of Simplex Electric, has been appointed joint managing director.

Dr. J. PEARSON, M.SC., F.R.I.C., assistant director of the British Iron and Steel Research Association, will from September 1 take over charge of the Sheffield laboratories and will have his office at Hoyle Street, Sheffield, 3. He will retain the headship of the steelmaking division but will relinquish control of the chemistry department for which Mr. E. W. VOICE, head of the ironmaking division, will become responsible. Mr. R. MAYORCAS will be appointed deputy head of the steelmaking division.

Obituary

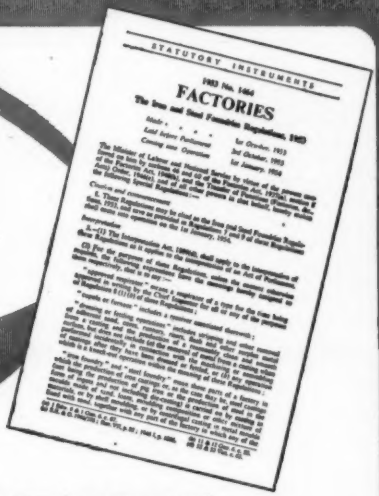
Lt.-Gen. Sir OTTO LUND, who was a director of the Sterling Engineering Company, Limited, Dagenham (Essex), and the Universal Asbestos Manufacturing Company, Limited, Watford (Herts), has died at the age of 64.

Mr. THOMAS FRAZER MACKIE died on August 16 at the age of 86. He was chairman of James Mackie & Sons, Limited, the Belfast textile machinists, which is one of the largest industrial enterprises in the United Kingdom to carry on in private hands. He was appointed CBE in 1943 in recognition of his company's outstanding services in the war effort.

Mr. CHARLES SIDNEY BACHE, chairman of George Salter & Company, Limited, West Bromwich, died on August 21 at the age of 76. He was vice-president of the National Union of Manufacturers and at one time chairman of the Birmingham committee. He was also the first president of the Hardware Trade Alliance (now the National Hardware Alliance) and a former mayor of West Bromwich. His son, Mr. R. P. S. Bache, is the managing director of George Salter & Company, Limited, and another son, Mr. G. P. Bache, holds a similar position with the firm's Australian subsidiary at Melbourne.

ENGLISH STEEL CORPORATION, LIMITED, Sheffield, has repaired and renovated its 7,000-ton press in its heavy forge department, which is the largest general forging press in the British Commonwealth. The work included shrinking into the 65-ton cylinder, a 7-ton stainless steel lining 12 ft. 6 in. long with a 2-in. thick wall and an internal diameter of 5 ft.

for Foundry Floors and Gangways - Refractory Concrete is the Ideal Material


STATUTORY INSTRUMENTS

1953 No. 1464

FACTORIES

The Iron and Steel Foundries Regulations, 1953

The Iron and Steel Foundries Regulations 1953 say "Foundry gangways and Pouring Aisles shall have an even surface of hard material, and shall not have on them more sand than is necessary to avoid risk of flying metal from accidental spillage." The use of Refractory Concrete (made with Ciment Fondu and crushed firebricks or grog) will enable you to fulfil these conditions speedily, because Refractory Concrete . . .

. . . has a high cold strength and is ready for full use 24 hours after placing.

. . . will withstand repeated spillages of molten metals and direct contact of hot castings without spitting and blowing.

. . . needs no sand covering.

. . . is non-spalling under widest fluctuations of temperature and highly resistant to all forms of mechanical shock.

Photograph by courtesy of Globe Tank & Foundry (Wolverhampton) Ltd.

REFRACTORY CONCRETE

The Adaptable Refractory material made with crushed firebrick and

CIMENT FONDU
ALUMINOUS CEMENT

Concrete Rock-Hard within one day

LAFARGE ALUMINOUS CEMENT COMPANY LIMITED
73 BROOK STREET, LONDON, W.1. TELEPHONE: MAYFAIR 8546
★ *You are invited to write for further details and photographic examples.*

AP3/130

News in Brief

ACCORDING TO local Press reports, the premises of E. Beck & Son, Limited, foundry engineers, at Luton Street, Keighley, have been destroyed by fire.

THE third International Automation Exposition is to be held at the new Trade Show Building, 500, Eighth Avenue, New York City, from November 26 to 30.

EMPLOYEES of Ley's Malleable Castings Company, Limited, Derby, who have been on a four-day week since August 14, resumed full-time working on August 27.

MODERN SHOWERBATHS have been installed at the Meadow Lane Foundry of Wallis & Longden, Limited, lace machine manufacturers, of Trent Works, Long Eaton.

A 20-TON cast steel cogging roll found to have a badly cracked spline, was welded using Quasi-arc electrodes and has since rolled over a hundred thousand tons of ingots.

THE ESTABLISHMENT of a large iron-ore storage and transhipment business at Rotterdam for the supply of ore to the whole of Western Europe is contemplated by the Hanna Iron Ore Company, Cleveland, US.

NEW PLANT now in operation at the works of Cia. Metalurgica Barbara, Barra Mansa, Rio de Janeiro State, Brazil, is expected to increase production of cast-iron pipes and fittings to 60,000 tons a year.

THE WHOLE of the first year's production of lead ore from the Mestersvig mines in Greenland, said to be about 7,000 tons, has been sold to Belgium. Next year's production is expected to be about 18,000 tons.

A NEW AMENITIES BLOCK, including showers and clothes lockers, is being built for the foundry staff at the British Railways (Eastern Region) works, at Doncaster, and will meet the needs of 130 foundry workers.

SHIPBUILDING and engineering projects are being discussed with the Chilean Government by Mr. L. Redshaw, Mr. J. E. Richardson, and Mr. W. J. Scott, members of the staff of Vickers-Armstrongs, Limited, London, S.W.1.

A CONTRACT has been secured by the Brightside Foundry & Engineering Company, Limited, Sheffield, from British Insulated Callender's Cables, Limited, for a semi-continuous copper rod mill. The mill will have an output of some 50,000 lb. per hour of high-quality copper rod.

THE PREMISES of Challingsworth, Limited, iron-founders, of Heath Street, Birmingham, were severely damaged by fire on August 22. The damage was estimated by an official of the firm at between £8,000 and £10,000. He added that production will probably be held up for some weeks.

THE Dunswart Iron and Steel Works, Limited, are installing at their Benoni works two 10-ton Demag electric furnaces and one five-ton unit of Birlec manufacture, capable of producing 50,000 tons of liquid steel yearly, of which 10,000 will be used by the steel foundry and the balance by the rolling mills.

A CARGO LINER of 10,000 tons d.w. has been ordered from the Caledon Shipbuilding & Engineering Company, Limited, Dundee, by Alfred Holt & Company, Limited, Liverpool. Diesel propelling machinery will be supplied by John G. Kincaid, Limited, Greenock. Two sister-ships will be built by Vickers-Armstrongs (Shipbuilders), Limited, at Walker-on-Tyne.

AN ORDER for six Muir-Hill 4½-cub. yd. dumping machines has been received by E. Boydell & Company, Limited, of Manchester, from the Spanish Ministry of Agriculture. The company has already supplied four similar machines to Spain, where the Ministry is using them for land-reclamation projects. The newly ordered machines will enable this work to be extended.

AN ORDER valued at £750,000 covering the electrical equipment for a four-stand tandem cold rolling mill for steel strip has been placed with the British Thomson-Houston Company by the Steel Company of Wales, Limited. The mill is to be installed at the Steel Company's Abbey Works, Port Talbot, and is for turning out steel strip up to 50 in. wide at a maximum speed of 3,500 ft. per min.

ACCORDING to *Aluminium News*, the General Motors Corporation has patented an aluminium-base bearing alloy which contains from 0.5 to 9.0 per cent. silicon, from 0.2 to 5.0 per cent. cadmium, and from 0.1 to 5.0 per cent. chromium, the balance being aluminium. It is further stated that for optimum corrosion resistance indium may be included in the alloy—preferably from 0.1 to 0.15 per cent.

LARGE deposits of bauxite have been found on the west coast of Cape York Peninsula, the far northern tip of Australia. Announcing the discovery, Mr. L. B. Robinson, chairman of the Consolidated Zinc Corporation, Limited, said the deposits were on the Gulf of Carpentaria. There were hundreds of millions of tons of bauxite. It was not possible to say much about development until its grade had been proved.

THE United Kingdom associates of the International Honeywell organization have opened a branch office in Belfast under the supervision of Mr. W. J. Edwards. The branch offers assistance with the choice, installation, and maintenance of the company's industrial instrumentation, precision snap action switches, and automatic controls for heating and air-conditioning systems. Inquiries should be addressed to Honeywell-Brown, Limited, 123, Cumberland Road, Dundonald, Belfast.

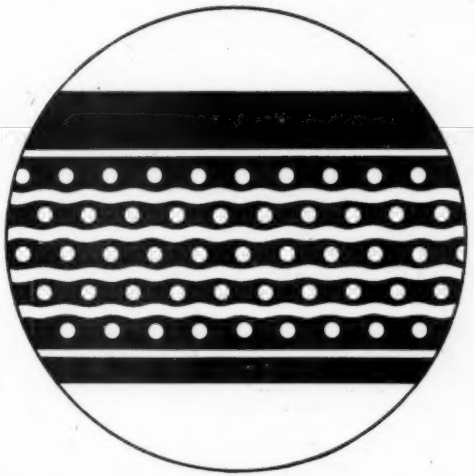
A GAS TURBINE developed by Ruston & Hornsby, Limited, Lincoln, is to be produced and sold in the United States by Clark Bros., a leading maker of machinery for the gas, oil, and chemical industries, as the result of an agreement completed earlier this year. The project for the manufacture of the turbines is reported to involve several million dollars, although the site for the new plant has not yet been decided. Initially, Clark Bros. will import turbines from this country and stock parts in the US.

TO IMPROVE COMMUNICATIONS in the central and suburban areas of Calcutta it has been decided to electrify certain sections of the Eastern Railway. Work on the first stage, covering the main line between Howrah and Burdwan and the branch line to Tarakeswar, has begun. British Insulated Callender's Cables, Limited, in conjunction with their associates the Indian Cable Company, Limited, have been awarded the contract, valued about £250,000, for the supply and installation of the underground power and control cables.

A NEW COMPANY has been set up in Colombia to assemble and manufacture Austin vehicles in Bogota. It is to be known as Fabrica Colombiana de Automotores S.A. and will produce a minimum of 5,000 Austin vehicles of all types each year. Over two years have been spent in negotiations and the planning of the project which will take a further four years to reach maturity. It is anticipated, however, that vehicles will begin to leave the production lines during the next 15 months. They will be built largely from components shipped from Britain.

(*Continued on page* 244)

Focus on conveyor belting proves Goodyear superiority



There is obviously only one way of proving to yourself beyond any doubt that Goodyear conveyor belting gives long and reliable service. That's by installing it.

But for proof in advance there's the record of efficiency of Goodyear conveyor belts in thousands of existing installations in this country—in steelworks, power stations, mines, quarries, factories and foundries.

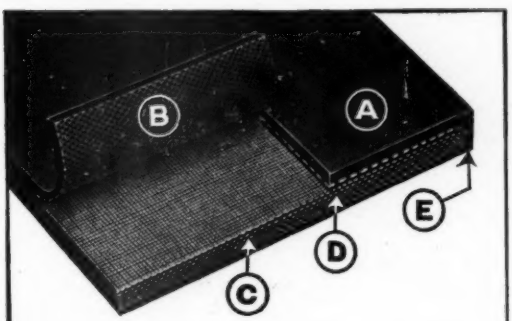
At a big steelworks, for instance, Goodyear belts conveying hot sinter are lasting over twice as long as other makes previously used.

QUICK PROOF

Focus on conveyor belting proves Goodyear superiority, and quickly confirms that Goodyear belting makes every conveying job an economic proposition.

The emphasis is on *every*. Whatever the conveying work, there's a "job-designed" Goodyear belt to do it at the lowest cost per ton.

This cost-saving is ensured by the exceptionally high quality built into every Goodyear belt. And this quality is ensured by rigid adherence to raw material specifications and stage by stage production inspection.



RUGGED CONSTRUCTION OF GOODYEAR BELTING

A Tough, heavy-duty cover compounded to suit job.
B Breaker fabric to improve bond between cover and carcass—when required.
C Plies of close-woven duck, inhibited against mildew.
D Skim coat between plies prevents separation.
E Rugged edge cover resists wear.

QUICK DELIVERY

You can now get quick delivery of Goodyear conveyor belts, which are available with cotton or rayon carcass in any width up to 72 inches. They can be supplied in a few weeks against specific ordering.

GOODYEAR INDUSTRIAL RUBBER PRODUCTS

CONVEYOR BELTING · TRANSMISSION BELTING · V-BELTS · INDUSTRIAL HOSE

News in Brief

(*Continued from page* 242)

ART FOUNDING was "on the air" last Saturday in the European service of the BBC, in a recording of a conversation between Mr. A. L. Parrott of the Morris-Singer foundry and the BBC interviewer, Christopher Burstall. The topic was the casting of bronze statuary with particular reference to the 18-ft. 6-in. figure of Sir Jacob Epstein's "Christ", recently completed at the foundry. The recording was interspersed with general remarks on art-casting practice, and the dialogue came over well to listeners in this country also.

FOLLOWING the success of a similar scheme last year, six science masters from grammar schools in the Manchester and Liverpool districts have been invited to spend a few weeks in the Trafford Park works of the Metropolitan-Vickers Electrical Company, Limited, working in departments of special interest to them. The arrangements were made by Dr. Willis Jackson, the company's director of research and education, through the north-west branch of the Science Masters' Association, and are designed to further the policy of closer co-operation between industry and schools.

A NEW AUTOMATIC TRIPLE DRAWBENCH, capable of cold drawing over 10 miles of light-alloy tubing every hour in individual lengths of up to 130 ft., has completed its initial trials and is now in full production at the Kitts Green, Birmingham, works of James Booth & Company, Limited. The drawbench, believed to be the only one of its kind in the world, is over 250 ft. long and is completely controlled by one man. Light alloy tubes can be produced three at a time at a drawing speed of 450 ft. per minute. The drawbench was designed and manufactured by Head, Wrightson & Company, Limited, Thornaby-on-Tees.

WALSALL AND DISTRICT PRODUCTIVITY COMMITTEE is to follow up the recommendation made by a British Productivity Council team who suggest a technical advisory service for small firms. The report stresses that small firms in Britain—those with fewer than 100 employees—total about 40,000. In Walsall, which has a concentration of small firms, many of them foundry and metalworking units, it is felt that an advisory service would serve a very useful purpose. A circuit scheme is already operating and appreciated by those firms which make visits to other works. Mr. R. W. Latham, chairman of the local productivity committee, hopes to see an advisory service on a local part-time basis launched shortly.

IT IS EXPECTED that when the parties organized through the Institute of British Foundrymen leave London on Friday for the International Foundry Congress and Exhibition at Dusseldorf (September 1 to 9), they will represent the great majority of the 200 or more from this country who are expected to attend. Some will travel by air, the majority by rail/sea, and a few are going by road/sea. After the conference, a number of delegates will stay a further week in Germany for participation in the post-Congress tours, of which a choice of three is offered, mainly to foundry centres in or adjacent to the Rhine valley. This is believed to be the largest party from the founding industry ever to leave this country.

THE CEILING of the Large Hall of the Cutlers' Hall, Sheffield, is being restored to its original design in time for the meetings of the British Association for the Advancement of Science to begin in the city at the end of this month. The designs of Hugh Stannus, executed by the Alfred Stevens School of Design and Decoration, were painted out some time ago but the original drawings have been discovered at the British Museum and Dr. R. Seddon, director of the Sheffield City Art Galleries, has helped in enabling them to be loaned for the present work. To the central ceiling panel, the coats of arms of the Cutlers' Company, the City of Sheffield, the Sheffield University and Diocese of Sheffield, and the West Riding of Yorkshire have been added.

IN BIRMINGHAM recently a spokesman of the Midland Council of the National Union of Manufacturers announced that the plan to build factory colonies for firms displaced by Birmingham's redevelopment schemes, has been abandoned mainly because of the high costs involved. Nearly two years have been spent in research and development of the project in which some 200 firms orginally expressed interest. Finally, 40 firms agreed on a tentative project but this number was gradually whittled down to less than 20. Mr. G. W. Donovan, secretary of the steering committee which was set up by the Council to pilot the scheme, believes that many firms are finding satisfactory solutions to their premises problems as a result of their own efforts. Some firms involved were foundries.

STRONG FOREIGN COMPETITION is responsible for the reorganization of manufacturing arrangements in the Birmingham group of factories of the cycle division of Tube Investments, Limited, it was stated recently. The scheme will involve the transfer from one factory to another of some hundreds of the group's 6,000 employees and will begin to operate at the end of September, it was disclosed. The four factories concerned are Phillips, Limited, and Walton and Brown, Limited, at Smethwick; Hercules Cycle Company, Limited, Aston, Birmingham, and Armstrongs, Limited, at Oldbury. Plans for the reorganization were first outlined at a meeting with shop stewards after which an official statement was made which said that the object of the replanning was to co-ordinate manufacturing policy so that products of one kind were made in one place, rather than in two or more places as at present.

ALTHOUGH other men were working nearby, none actually saw the cause of an accident to an employee at a West Bromwich foundry, which resulted in his death, a West Bromwich inquest jury was told on August 23. A verdict of "Accidental death" was returned. It was stated that the man was working on a centre-lathe on which he was boring part of a pressure-die. One witness said he saw that the man appeared to have been thrown violently backwards and thought he struck his head on part of the lathe, another said he heard what sounded like the crack of a whip and saw the deceased lying near the lathe. Both men said the floor was clear of oil or objects which might have caused the fall. Death was said to have been caused by injuries consistent with the man's head having come into contact with a revolving object. The deputy coroner, Mr. G. Piddock, said: "We are left rather in the air as to how the accident happened."

Courses at Sir John Cass College

The Sir John Cass College, Jewry Street, Aldgate, London, E.C.3, is this year organizing special evening courses on a multiplicity of subjects. For readers of the JOURNAL, the most interesting ones are those covering "Radiochemistry and Radioactivity"; "Absorption Spectroscopy"; "Spectro-Chemical Analysis"; "Scientific Principles of Fuel Technology"; "Solid and Gaseous Fuels"; "Industrial Law" and "Domestic and Industrial Fuel." Details of each of these courses can be had by writing to the secretary of the College, at Jewry Street.

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Raw Material Markets

Iron and Steel

Now that most of the foundries have finished their annual holidays, they are reviewing their future requirements of raw materials. Stocks and the volume of work in hand are, of course, the major items to be considered in this regard. For some time past most users of pig-iron have been content to specify only those tonnages needed to cover immediate requirements and to provide for a working stock and, in view of present conditions, it is unlikely that they will depart from this course. Very few foundries have large stocks and tonnages on hand are generally earmarked for orders already on the books. The suspension of deliveries during the holiday period has resulted in some accumulation at the furnaces, but this is not large and it is expected that stocks will be cleared quickly. Recently, however, producers have been able to offer for export limited tonnages of all grades of foundry iron except hematite. There is a good demand from the steelworks for hematite, while the engineering foundries are also taking up appreciable quantities so that producers are able to dispose promptly of their outputs.

Many of the engineering foundries continue to obtain good outputs of high-duty castings, but those supplying mainly to the motor-car industry are often unable to obtain sufficient orders to keep them on full production; in fact, it is probable that there will be a further reduction in the outputs of these foundries. This has resulted in decreased demands for low-phosphorus iron, supplies of which appear to be more than sufficient to satisfy demands, and some makers are able to extend their allocations to cover new customers. Many of the light and jobbing foundries are quiet and have capacity available for increased business. The call for high-phosphorus iron is dull; orders are only being placed as stocks are cleared.

Most of the foundries have fairly good stocks of scrap, while coke deliveries are maintained.

The re-rollers are fairly well provided with steel semis, but increased deliveries are required from home steelworks, as the re-rollers are likely to have to rely increasingly on supplies from home sources if, as expected, imports continue on a reduced scale. Current deliveries are not equal to requirements and this has resulted in a reduction of stocks at many mills. Orders on hand for most of the re-rollers' products are plentiful. Some export business is offering, but only a small proportion of it can be taken up. With the reduced demand from the motor vehicle trade, strip re-rollers are less busy than they were, but there is a strong demand for small bars and light sections.

Non-ferrous Metals

The Suez crisis continues to dominate the non-ferrous metal markets. Business is largely of a routine nature and no change in this situation is looked for until developments concerning the canal are clarified. The copper markets in London and in New York are sluggish. Holidays are a factor and in London there is also the uncertainty connected with the yet-to-be-announced method by which the Government will dispose of its copper stocks. Nevertheless, buying is satisfactory, although far from strong. In the United States, the big producers are still clinging to their price of 40 cents, but the Custom smelters have dropped their quotation by ¼ cents to 39 cents and dealers are offering the metal at 38½ cents a pound. Business is poor at all three levels and it may well be that buyers are waiting for the price to go lower. Time may not be on their side, but with copper stocks totalling 465,015 tons at the end of July—the highest for nine years—and consumption in July down more than 30,000 tons from the June figure, they can afford to wait.

While the possibility of a strike occurring at the Garfield refinery belonging to American Smelting & Refining ought to be borne in mind, the crucial labour situation is that on the Rhodesian Copperbelt. Three day "rolling strikes" have been held at every Copperbelt mine and at Broken Hill and the fear now is that the African Mineworkers' Union will call a general strike.

Tin is quietly steady in London and, though slow in New York, signs are there of a broadening demand from tinplate manufacturers. On the London Metal Exchange the price is fluctuating according to feelings concerning the Suez discussions. London and Cairo advices at present hold sway in this market, especially now that the Malayan tin strike has been averted and the Nigerian labour dispute is yielding to negotiations. The US price has held steady at not far below $1.00 a pound, with demand for electrolytic tinplate good to the point of being insistent from some quarters.

Demand for lead is fairly good in London, but quite satisfactory in the US, where battery manufacturers are active buyers, largely for September metal. Purchases from cable makers is falling away, yet there are no large stocks overhanging the market and some producers are expected to make only token offerings to the Government stockpile. Stocks in producers' hands at the end of July totalled 49,134 tons, an increase of 3,183 tons over the preceding month.

Zinc is still weak in London, although demand would appear to be improving in America. Occasional bursts of buying of "Prime Western" and of special high grade has raised hopes in this market, but the sad fact is that there is no follow-through and if the price is to hold its present level buying must expand considerably —and soon.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* August 23, £298 to £298 10s.; August 24, £295 to £295 10s.; August 27, £296 10s. to £297; August 28, £294 to £294 10s.; August 29, £296 to £297.

Three Months: August 23, £298 to £299; August 24, £295 to £295 10s.; August 27, £296 10s. to £297; August 28, £293 10s. to £294; August 29, £296 to £297.

TIN, Standard—*Cash:* August 23, £772 to £774; August 24, £768 to £769; August 27, £766 to £767; August 28, £762 to £764; August 29, £763 to £764.

Three Months: August 23, £770 to £771; August 24, £766 to £767; August 27, £765 to £767; August 28, £761 to £762; August 29, £761 to £763.

LEAD—*Second half August:* August 23, £115 to £115 5s.; August 24, £114 10s. to £114 15s.; August 27, £114 10s. to £114 15s.; August 28, £114 15s. to £115; August 29, £114 10s. to £115.

Second half November: August 23, £114 to £114 5s.; August 24, £113 15s. to £114; August 27, £113 10s. to £113 15s.; August 28, £113 15s. to £114; August 29, £113 15s. to £114.

ZINC—*Second half August:* August 23, £94 15s. to £95; August 24, £94 to £94 5s.; August 27, £93 15s. to £94; August 28, £94 5s. to £94 10s.; August 29, £94 5s. to £95.

Second half November: August 23, £92 15s. to £93 5s.; August 24, £92 5s. to £92 10s.; August 27, £92 10s. to £92 15s.; August 28, £93 to £93 5s.; August 29, £93 5s. to £93 10s.

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

August 29, 1956

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 11s. 0d.; Birmingham, £17 3s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £20 8s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £20 12s. 3d.

Scotch Iron.—No. 3 foundry, £21 14s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £23 16s. 6d.; South Zone, £23 19s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 4s. 0d.; South Zone, £25 6s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent. :—N.-E. of England (local iron), £21 7s. 6d.; Scotland (Scotch iron), Zone S. 1, £21 14s. 0d.; Sheffield, £22 14s. 6d.; Birmingham, £23 2s. 0d.; Wales (Welsh iron), £21 7s. 6d.

Basic Pig-iron.—£18 3s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £48 0s. 0d. to £50 5s. 0d., scale 10s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £73 2s. 6d., scale 16s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 27s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £250 0s. 0d.; 38/40 per cent., £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 17s. 0d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 20s. 0d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent.C, £93 10s.0d. to £95 0s. 0d., basis 60 per cent. Cr, scale 29s. 9d. to 32s. 0d. per unit; over 6 per cent. C, £92 10s. 0d. to £93 0s. 0d., basis 60 per cent. Cr, scale 29s. 9d. to 32s. 0d. per unit; 2 per cent. C,* 2s. 1d. per lb. Cr; 1 per cent. C,* 2s. 1¼d. per lb. Cr; 0.15 per cent. C,* 2s. 2¼d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d.; 96/98 per cent., £259 0s. 0d. to £265 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 6d. to 23s. 6d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £66 0s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £28 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £29 19s. 0d.; hard (0.41 to 0.60 per cent. C), £31 0s. 6d.; silico-manganese, £39 10s. 0d.; free-cutting, £33 3s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £36 14s. 6d., silico-manganese, £39 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £34 13s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £35 16s. 0d.; acid, up to 0.25 per cent. C, £38 17s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £35 7s. 0d.; boiler plates (N.-E. Coast), £37 17s. 0d.; floor plates (N.-E. Coast), £36 16s. 0d.; sectional material, N.-E. Coast, £33 16s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £36 3s. 0d.; flats, 5 in. wide and under (4-ton lots), £36 3s. 0d.; hoop and strip, £36 12s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £38 16s. 0d.; black sheets (hand mill), 17/20 g., £50 4s. 6d.; galvanized corrugated sheets, 24 g., £62 7s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £61 13s. 9d.; nickel-chrome, £85 10s. 6d.; nickel-chrome-molybdenum, £96 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £296 0s. 0d. to £297 0s. 0d.; three months, £296 0s. 0d. to £297 0s. 0d.; settlement, £297 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 10d. per lb.; rods, 331s. 0d. per cwt. basis: 20 s.w.g., 364s. 3d. per cwt.

Tin.—Cash, £763 0s. 0d. to £764 0s. 0d.; three months, £761 0s. 0d. to £763 0s. 0d.; settlement, £764 0s. 0d.

Lead (Refined Pig).—Second half August, £114 10s. 0d. to £115 0s. 0d.; second half November, £113 15s. 0d. to £114 0s. 0d.

Zinc.—Second half August, £94 5s. 0d. to £95 0s. 0d.; second half November, £93 5s. 0d. to £93 10s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £125 5s. 0d.; rolled zinc (boiler plates), all English destinations, £123 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £110.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 3¾d. per lb.; rods, drawn, 3s. 2½d.; sheets to 10 w.g., 315s. 0d. per cwt.; wire, 3s. 0d.; rolled metal, 300s. 3d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £193; B6 (85/15), —; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), —; HTB2 (38 tons), —; HTB3 (48 tons), —.

Gunmetal.—BS1400, LG2 (85/5/5/5), £263; LG3 (86/7/5/2), £275; G1 (88/10/2/½), £376; (88/10/2/1), —.

Phosphor Bronze.—BS1400, PB1 (AID released), — per ton.

Phosphor Bronze Strip, etc.—Strip, 434s. 0d. per cwt.; sheets to 10 w.g., 458s. 6d. per cwt.; wire, 4s. 6d. per lb. rods, 3s. 10d.; tubes, 3s. 8½d.; chill cast bars: solids 3s. 9½d., cored 3s. 10½d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 1½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 6d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 5d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 4d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £83 10s. 0d. Nickel, £519 0s. 0d. Aluminium ingots, £198 10s. 0d.; aluminium bronze (BS1400), AB1, £305; AB2, —. Solder, brazing, BS1945, type 8 (50/50), 3s. 1d. per lb., type 9 (54/46), 3s. 4½d. per lb.

* Average 68-70 per cent.

House Organs

The Iron Worker—Summer, 1956. Published by the Lynchburg Foundry Company, Lynchburg, Va., USA.

For the last few years, it has been the custom of this magazine to carry articles covering the history and cultural development of the State of Virginia. Though it covers a period of but 350 years, many valuable historical records would have been lost but for the enthusiasm of local archæologists, amongst whom, Mr. J. Paul Hudson, the author of the main article in this issue, is a prominent leader, as he is curator of the museum devoted to this study.

It was interesting to learn from this publication that in 1609, a consignment of iron ore was sent to England and from it about 16 tons of iron was made. On the technical side, there is an interesting article on shell-moulded castings, written by Mr. William C. Phillips of the sales staff. Included are a number of pictures of the same casting made by the conventional and new processes. Outstanding is a casting made of ductile (nodular) iron which has replaced a weldment. A second account tells of a wet-spray process used in the firm's de Lavaud centrifugal pipe shop to replace the powdered ferro-silicon dressing formerly applied to the moulds.

Close-up. Issued by Armstrong Whitworth (Metal Industries) Limited and Jarrow Metal Industries Limited, Close Works, Gateshead.

This issue contains an article by Mr. T. A. Bird on his visit to South Africa in order to give service to customers in the Dominion and Rhodesia. Although it includes an unfortunate picture of one man yawning during a speech, this issue well maintains the high standard achieved in its initial publication.

Increases in Capital

JAMES O'FLANAGAN, LIMITED, engineers, etc., of Coventry, increased by £19,000, in £1 ordinary shares, beyond the registered capital of £6,000.

THOMAS BARKER & SONS, LIMITED, bakery engineers and fitters, etc., of Manchester, increased by £44,500, in £1 ordinary shares, beyond the registered capital of £5,500.

THOMAS WALMSLEY & SONS, LIMITED, iron and steel stockholders, engineers, etc., of Bolton, increased by £55,000, in £1 ordinary shares, beyond the registered capital of £100,000.

TARS & OILS, LIMITED, London, S.W.1, increased by £19,000, in 16,880 4 per cent. non-cumulative preference and 2,120 unclassified shares of £1, beyond the registered capital of £1,000.

SEAWARD ENGINEERING, LIMITED, London, N.W.10, increased by £10,000, in 500 ordinary and 9,500 7 per cent. non-redeemable cumulative preference shares of £1, beyond the registered capital of £2,000.

JOHN ROBY, LIMITED, brassfounders, etc., of Rainhill (Lancs), increased by £60,000, in 40,000 "B" ordinary and 20,000 7 per cent. cumulative preference shares of £1, beyond the registered capital of £20,000.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

INDIA, September 6—Steel well casing pipe, cast-iron water pressure pipe, valves, and fittings, for the Government of India, India Supply Mission, Washington, DC, USA. (ESB/20304/56.)

AUSTRALIA, September 13—Lathes, wheels sets, grinders, welders, furnaces, and air compressor, for the Queensland Railways. (ESB/20755/56.)

NEW ZEALAND, October 5—Overhead electric cranes, for the Wellington Harbour Board. (ESB/20439/56.)

OTLEY (YORKS), September 29—Pumping machinery, for the Urban District Council. The Surveyor, North Parade, Otley. (Deposit, £5.)

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PREPAID RATES: Fifteen words for 7/6 (minimum charge) and 4d. per word thereafter. Box Numbers 2/6 extra (including postage of replies.) Situations Wanted 2d. per word.

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, John Adam House, 17/19, John Adam Street, Adelphi, London, W.C.2. If received by first post Monday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS WANTED

METALLURGIST (33), L.I.M., H.N.C., desires post (West Midlands preferred but not essential). Wide experience grey, high duty and malleable irons. Cupola and sand control in modern mechanised foundries. Extensive practical foundry experience both on production and development work. Replies in confidence to Box MT295, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN seeks similar position in Light Castings Foundry. Over 30 years' experience in mechanisation, plate, jobbing. Energetic, intelligent, disciplinarian.—Box FF292, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (30) of large iron foundry wishes to become associated with a small family business producing light weight castings requiring a capable conscientious man able to take complete control. Possesses expert knowledge on enabling loose patterns to be made by semi-skilled labour, stabilising labour turnover, and the most modern methods of production. Has proven ability to get results.—Box FM294, FOUNDRY TRADE JOURNAL.

FOUNDRY TECHNICAL SALES REPRESENTATIVE (47), practical foundryman, wide knowledge trade, car, 'phone, etc., available, many contacts Midlands, requires represent sound firm Equipment Manufacturers. Capable demonstration, Shell, CO_2. Sales commercial experience.—Box FT281, FOUNDRY TRADE JOURNAL.

FOUNDRY TECHNOLOGIST/METALLURGIST (25). National Foundry College Diploma holder. City and Guilds Patternmaking and Foundry Practice Certificates, desires progressive position anywhere in the country. Practical experience in every department of Cast Iron Casting Production.—Box FT276, FOUNDRY TRADE JOURNAL.

ENGINEER wishes to represent a Foundry for Grey Iron, Aluminium and Non-Ferrous Metals, Diecastings in Aluminium, Mazak, Lead and Tin Alloys, etc. First-class connection with works in London and Home Counties. Expenses and commission. Box EW277, FOUNDRY TRADE JOURNAL.

FOUNDRYMAN, 15 years' executive experience malleable and grey-iron, mechanisation, metallurgical control, jobbing work, shell-moulding, estimating, etc., seeks high-level appointment. Box FF273, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

ASSISTANT FOREMAN wanted (age 25-35) for Non-ferrous Foundry in N.W. London. Must be practical foundryman.—State experience, salary, etc., Box AF289, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

FOUNDRY MANAGER required for small Foundry on South Coast, producing high class jobbing work. Practical and technical knowledge of the production of ferrous and non-ferrous castings essential. Good opportunity for keen and energetic man. Staff pension scheme available after probationary period.—write, giving full details of past experience, Box FM290, FOUNDRY TRADE JOURNAL.

A FEW FURNACEMEN required for progressive Smelters and Refiners. Permanent jobs for conscientious men; liberal bonuses and Company's Pension and Life Insurance Schemes available.—Apply MITCHAM SMELTERS, LTD., Red House Road, Mitcham Road, Croydon. Tel.: THO. 6101.

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Applications stating reference SFJ.4 to:

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Lumm's Lane, Clifton Junction,
Swinton, Nr. Manchester.

AUSTRALIAN Steel Foundry, situated in N.S.W., requires the services of a STEEL SMELTER, with essential previous experience, which should include modern methods of production of carbon and alloy steels by direct arc electric furnaces. Must be strict disciplinarian and used to the control of labour. Applicants are invited to apply, stating full details of qualifications and experience to date and marital status.—Box AS268, FOUNDRY TRADE JOURNAL.

METALLURGIST required, about 35 years of age, for a small Iron Foundry which is to be modernised, mechanised, and expanded. Applicants should have the qualifications, practical experience, and aptitude to establish the necessary technical controls, and to take part in promoting a progressive programme for the rehabilitation of the Works and the extension of its activities. This post offers great scope to the successful applicant; salary will be according to ability, and it will be reviewed as progress is made.—Apply Box MR286, FOUNDRY TRADE JOURNAL.

ASSISTANT FOREMAN required for modern foundry producing about 50 tons of grey iron castings per week. Age about 30. Applicants to state experience and salary required to MANAGING DIRECTOR, Charles Roberts & Co. Ltd., Horbury Junction, Wakefield.

SITUATIONS VACANT—*contd.*

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in Tees-Side Steel Foundry. Previous fettling experience not essential. This is an important position of responsibility. Pension scheme, canteen facilities and assistance with house purchase if necessary. Apply stating age, full details of previous employment and salary required to Box FT272, FOUNDRY TRADE JOURNAL.

METALLURGISTS, METALLURGICAL CHEMISTS and SPECTROGRAPHER for work on non-ferrous metals and alloys required by large Founders in the London area. Good salaries according to qualifications and experience with opportunities for the right man. Pension scheme, restaurant and sports club. Write giving particulars to Box 3H P1543, A.K. Advg., 212a, Shaftesbury Avenue, London, W.C.2.

FOUNDRY FOREMAN required for Malleable and Grey Iron Foundry to take control of all moulding and melting operations.

Good opportunity for thoroughly experienced and progressive man. Please give full details of experience and salary required.

Apply: ALFRED H. MOULD & SONS, LTD., Stafford Street, Walsall.

LABORATORY ASSISTANT (20-22) for Grey Iron Foundry. Knowledge of general analysis essential.—Apply in writing to CHIEF CHEMIST, Harold Andrews, Sheepbridge, Ltd., Manor Lane, Halesowen, Birmingham.

IRON MOULDER, NON-FERROUS MOULDER, and IRON MACHINE MOULDER wanted.—MOYLE, Kingston-on-Thames.

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APPLICATIONS are invited for a variety of supervisory posts ranging from FOREMAN LEVEL to ASSISTANT WORKS MANAGER and ASSISTANT METALLURGIST, required to staff a new mechanised foundry which will be working in a few months' time.

Previous experience on Blackheart Malleable castings is an advantage, but is not essential.

There is good scope for advancement and a generous Pension scheme. Apply in writing, giving details of training, previous experience, and present salary level, to:—

Managing Director,
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Manchester Street, Oldbury.